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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 3 JANUARY, 1926 NUMBER 1

THE VALUE OF THE ROENTGEN RAY IN RHINOLOGIC DIAGNOSIS

WITH AN ELABORATION OF THE OBLIQUE METHOD OF RHESE *

W. P. WHERRY, M.D.

OMAHA

In 1916, before the Detroit Meeting of the American Medical Association, Iglauer presented a résumé of his experience in the use of the oblique position of Rhese, a position designed to show to the best advantage the ethmoid and sphenoid sinuses in roentgenograms. My interest was aroused at the time, and since this meeting I have used the method routinely. The advantage of the oblique position lies in the fact that it presents the sinuses in their anteroposterior dimensions, which allows a study of the separate cells and readily identifies the structures in question. Further, since the exposure is made through tissues of lesser density than is ordinarily the case, types of tissue changes, suppurative and nonsuppurative, are more easily recognized. This is especially true in stereoscopic exposures.

The oblique method requires unusual accuracy in the placing of the patient and the timing of the exposure. An error of a few degrees in position causes an overlapping of parts to such an extent that the entire region cannot be seen through the orbit. Stereoscopic roentgenograms are essential to careful diagnosis.

The oblique position observed in Figure 1 should show the sphenoethmoid labyrinth and the ethmofrontal region in their anteroposterior dimensions. The shadow of this region is thrown into the opposite orbital cavity, distorted to a very slight degree because of the oblique direction of the ray through the parts. The optic foramen being the posterior landmark, should seemingly rest on the orbital rim with the ethmoid roof line directed slightly downward, then upward, as it progresses forward toward the ethmofrontal region, the anterior landmark.

Figure 2 shows a normal ethmosphenoidal field and is from a patient, aged 24, who came complaining of headaches and distal focal symptoms, which were disposed of through the use of glasses and tonsillectomy. In this case the normal findings in the film, confirming those of the intranasal examination, excluded the sinuses from the clinical problem.

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* Read before The American Laryngological Association, Washington, D. C., May, 1925.

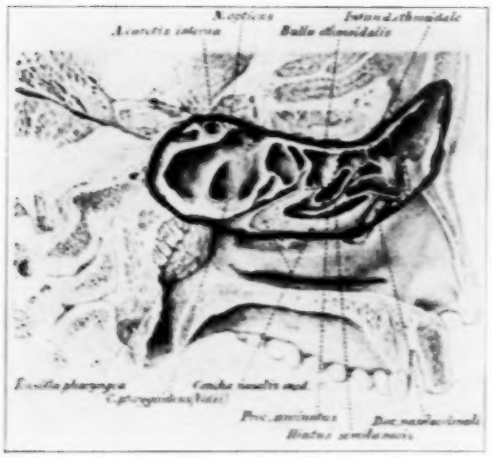


Figure 1

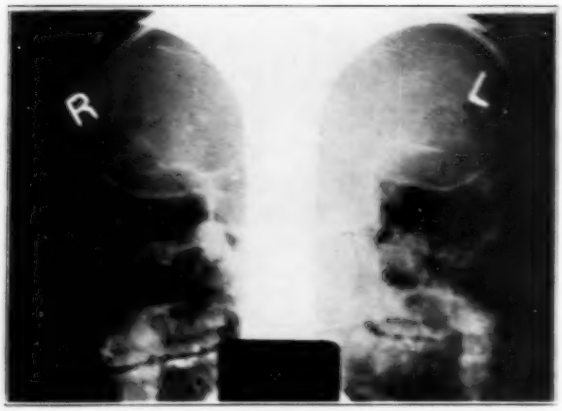


Figure 2

The two white circular patches observed in the lower and posterior parts of each field are the overlapping petrous portions of the opposite temporal bone.

There is a haziness around the agger nasi of each side which in the flat roentgenogram would be suspicious, but which stereoscopically observed proved to be the zygoma of the same size.

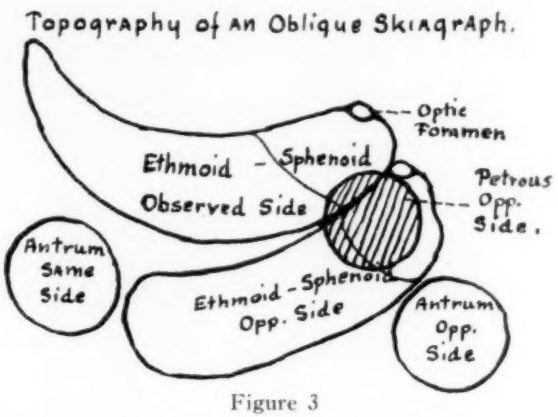


Figure 3

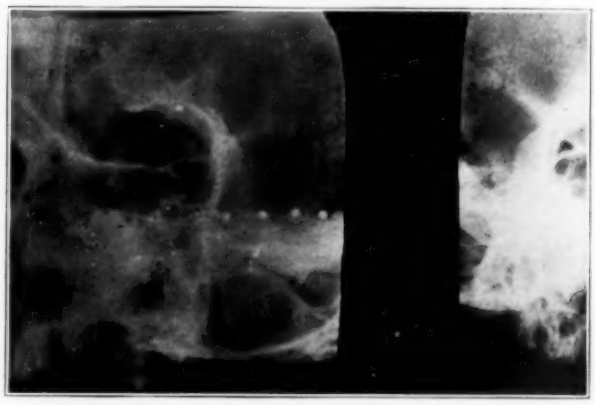


Figure 4

The topography of the various structures appearing on the oblique roentgenogram should, if the placement is correct, be as shown in Figure 3.

The next few roentgenograms, taken of dissected skulls in some instances, are shown to illustrate the difficulties in accurate interpretation when the placement of the head is incorrect.

In Figure 4, the head has been turned a few degrees to displace the optic foramen forward. As a result, the ethmoid field is brought

out in relief, but the ethmofrontal has been covered over by the nasal bones and the frontal processes of the superior maxillae. Note the petrous portions of each temporal bone; that of the same side extending posteriorly is seen in its longitudinal axis and is identified by small shot on the superior surface, while that of the opposite side is seen in cross section just below the sphenoid region and identified by large shot showing very faintly.

The roentgenogram (Fig. 5) illustrates another faulty position with the head tilted too much downward. The superior surface of the body of the sphenoid forming the roof of the sinus has been accentuated with barium paste to show how the shadow cast could be mistaken for tissue alteration within the sphenoid.

Figure 5

I am positively convinced of the necessity of stereoscopic roentgenograms to place accurately this annoying overlap in the study of the region in vivo.

The small shot outline the ethmoid—the larger shot mark, as nearly as possible, the floor of this sinus. Observe the thick petrous portion extending backward. Had the other half of the skull been used when this picture was taken, the petrous portion of that half would have completely blotted out the area we wished to show.

This roentgenogram (Fig. 6) shows how, when the placement is correct, the flat surface of the superior wall of the sphenoid sinus is prevented from interfering with the interpretation. To do this it is necessary to distort somewhat the contour of the optic foramen, as well as to place it as if resting on the orbital rim.

Barium paste of different percentages has been used in an attempt to simulate the shadows of living tissue changes in the ethmosphenoidal field. In this flat picture the observation is difficult, but stereoscopically seen, the opacities of these different pastes become apparent.

Figure 7 illustrates a faulty oblique position that comes to us frequently from those who are not familiar with the proper angles of

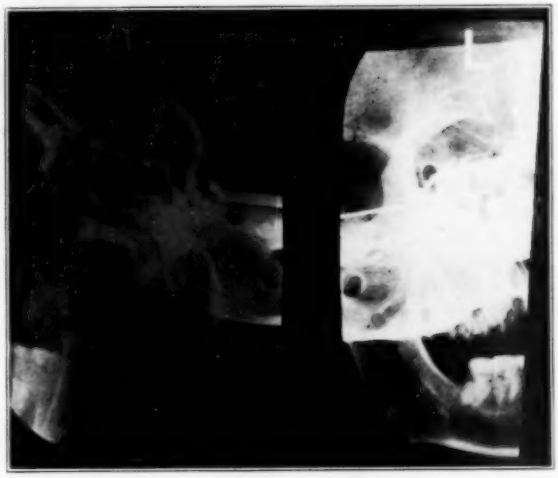


Figure 6

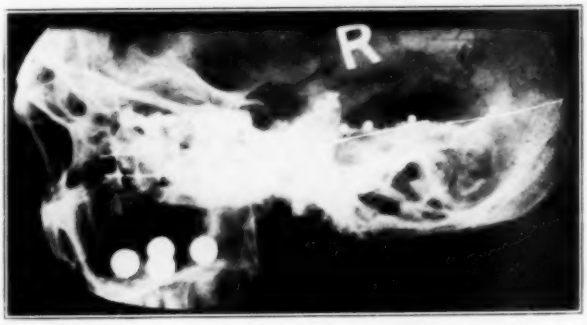


Figure 7

placement or who seem to be of the opinion that the oblique is a modified straight lateral.

Here the small shot identify the right side of the skull; the wire marks the left side. Observe that the desired field is a conglomerate mass of petrous portions and both ethmoids.

Two large shot are placed on the floor of each antrum. It will be noted how they overlap. I will show later how the two antrums appear when the placement is correct.

My point in this figure is to show the annoying handicap developed to correct interpretation when the placement has been carelessly made or the technic incorrect.

As contrasted to the faulty placement just shown, another roentgenogram (Fig. 8) is the better, although even here the tilting forward of the head borders on error.

Barium paste is used to show the ethmoid and sphenoid; while the petrous portions are identified by strips of tin pasted on their superior surfaces, small on the left and larger on the right; circular platelets are used to mark the several boundaries of each antrum and the sphenoid septum.

The antrum of the same side is placed forward as if in the tip of the nose with the malar bone and the nasal border of the superior

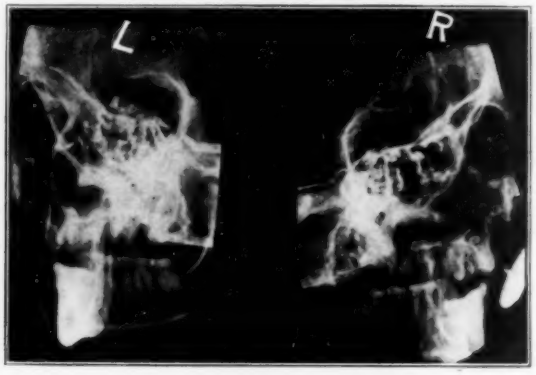


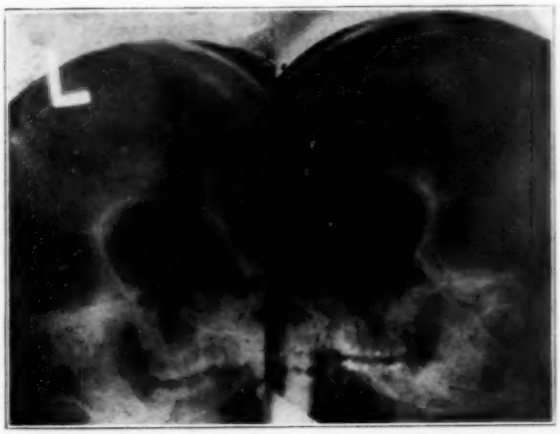
Figure 8

maxilla overlapping, while the antrum of the opposite side is posterior and down behind the petrous block.

We have been looking for tooth projections into the antral floor from this position, but have been disappointed so far. This roentgenogram does present a tooth projecting into each antrum.

The roentgenogram (Fig. 9) from a living subject exemplifies the type that is often sent to me for interpretation, and in which proper technical care has not been exercised in placement. An accurate reading regionally and otherwise is impossible in this sort of placement.

I have two reasons for showing Figure 10. First, because in the correct position as shown in the right, both sphenoids, right and left are sometimes brought out in comparative relief, one below the other. Incidentally, this right side is a normal sinus roentgenogram. The second reason is to show what sometimes happens in case of a careless placement, since the left position is thrown forward only a slight degree, yet enough to put it out of line with the right. This technical error,



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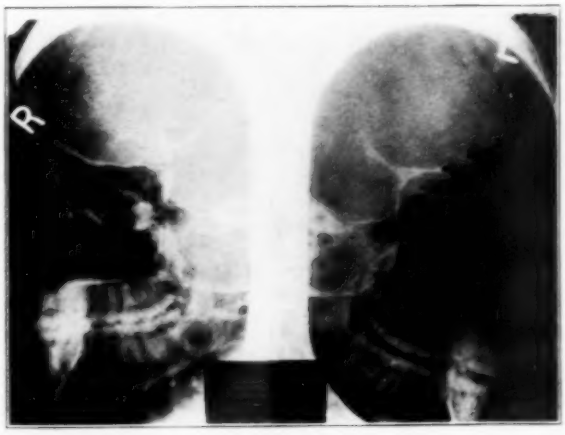

Figure 10

slight as it may be, could interfere with interpretative accuracy were only flat pictures used, but taken stereoscopically this difficulty becomes negligible.

Several of the following illustrations show the material assistance rendered by the roentgen ray in a diagnosis.

Figure 11 exhibits an unusually large sphenoid with a low-grade chronic hyperplastic process in both the sphenoid and posterior ethmoid, left side.

The patient, aged 46, came complaining of most violent periodic headaches, especially for the last few years. Drainage of the sphenoid did not entirely relieve the symptoms. I suggested it might be the impacted third molars, evidenced in the roentgenogram. The patient was in doubt, because his dentist had just advised him that the teeth

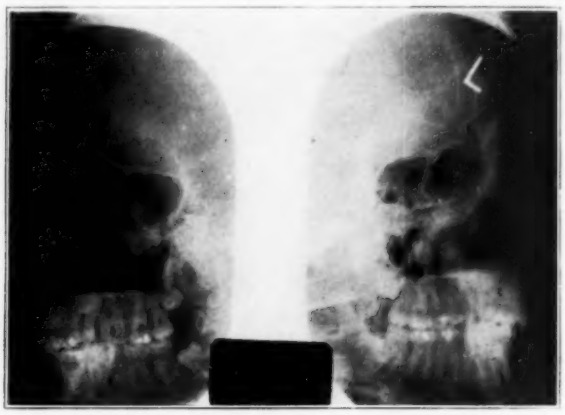

Figure 11

were not a factor. The dentist in turn was surprised to note the status of the third molars. They were extracted and the headaches disappeared. The end-result in this case emphasizes the value of roentgenograms in arriving at a complete diagnosis.

Figure 12 is from a case of chronic suppurative sphenoiditis, left, with a certain tissue change around the nasofrontal region as well as a chronic hyperplastic ethmoiditis, both sides. The diagnosis was confirmed by the operative findings.

Figure 13 illustrates a chronic posterior ethmoiditis, right, with some changes around the nasofrontal region, also a low grade hyperplastic ethmoiditis on the left side.

The petrous portion on the left has been placed to overlap the lower part of the sphenoid, and in flat pictures might prove annoying to the interpreter, but when stereoscopically taken can be observed properly.

Figure 12

Figure 13

Figure 14 shows a normal right side. A chronic nonsuppurative hyperplasia exists in the spheno-ethmoid field, left side. The patient, aged 42, complained of distal focal symptoms. Nasal examination was doubtful, yet surgical interference on the left side stopped the arthritis.

Since the acceptance of the focal infection syndrome, cases such as this, borderline so far as diagnosis, have become sufficiently frequent that an accurate use of the roentgen ray is imperative for a diagnosis.

This roentgenogram (Fig. 15) is from a patient, aged 49, who had headaches, with the characteristic syndrome of chronic ethmoiditis. It is so easy from a good roentgenogram taken in this position to know that the sphenoid must be drained along with the ethmoid.

Operative interference demonstrated the accuracy of the roentgenogram and my point is just that accuracy.

Figure 14

Chronic sphenoiditis on both sides, the left more especially, with spotted ethmoiditis, spotted so far as determining the areas of greatest involvement rather than as to typing the ethmoiditis, and a chronic suppurative process in the frontals are shown in Figure 16. The operative findings supported the diagnosis in all instances.

The frontal sinuses were drained intranasally without satisfactory results and will soon be drained externally, since the symptoms now are confined definitely to that sinus, those incident to the sphenoid having subsided postoperatively.

Diagnostic accuracy with proper placement is the point in evidence.

Figure 17 is of a woman, aged 68, and shows a chronic posterior ethmoiditis. The patient complained of scotomas and a varying degree of visual interference. Intranasal examination did not present any

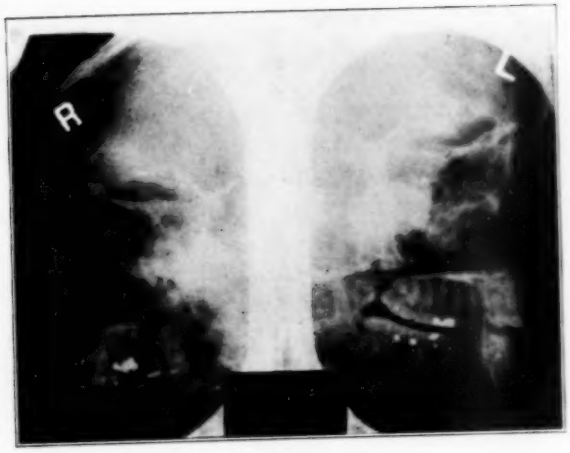

Figure 15

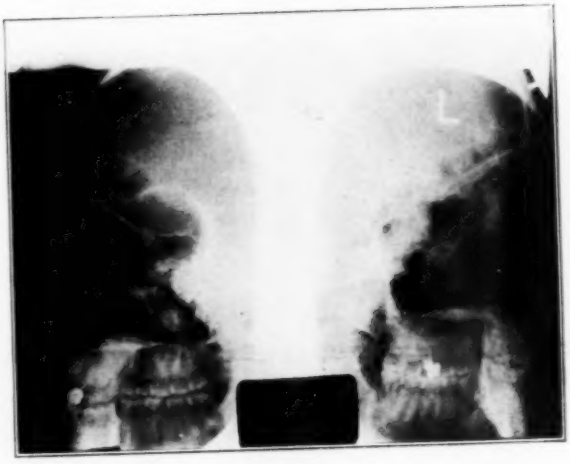

Figure 16

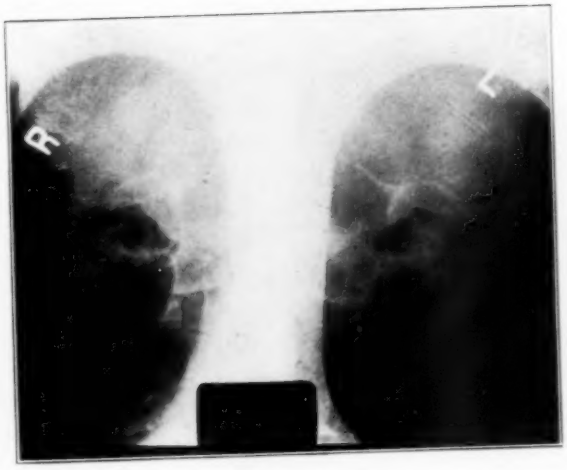

Figure 17

evidence of tissue alteration, and the Water's position for the antrums on this patient did not reveal the pathologic condition of the ethmoid.

Unfortunately, the ethmoid pathology was discovered too late to correct the ocular complex, although its progress was stopped through nasal surgery.

The next two illustrations are given because of their real merit in completing a surgical picture before operation.

In cases of chronic suppurative maxillary sinusitis, the upper nasal stratum of the affected side is always blocked from the swollen mucosa created through the constant flow of pus over it. At times it is exceedingly difficult to know whether to exenterate the ethmoid sinus when the radical antrum surgery is done. To do this in every case would be

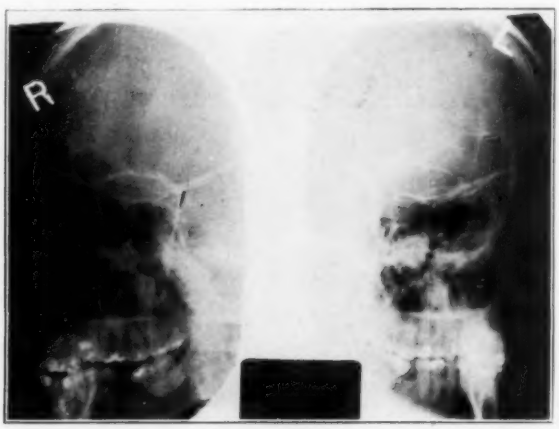

Figure 18

empiricism, while not to operate in the necessary instance would minimize the desired result in the antrums.

One roentgenogram (Fig. 18) is of a woman with such a process in the left maxillary sinus. From its interpretation conservative surgery was advised. The results proved the value of the judgment exercised in avoiding operation on the ethmoid labyrinth.

My point here is diagnostic accuracy.

The next roentgenogram (Fig. 19) is from another patient, a woman with a similar antral process and a similar appearance in the upper nasal stratum. Here exenteration of the ethmoid was indicated. Findings at operation proved that the course adopted was correct.

Figure 20 is of a most interesting, and at the same time a most perplexing, case. It shows a chronic right sphenoiditis. This is the third picture of this patient. The sphenoid was drained six years ago and

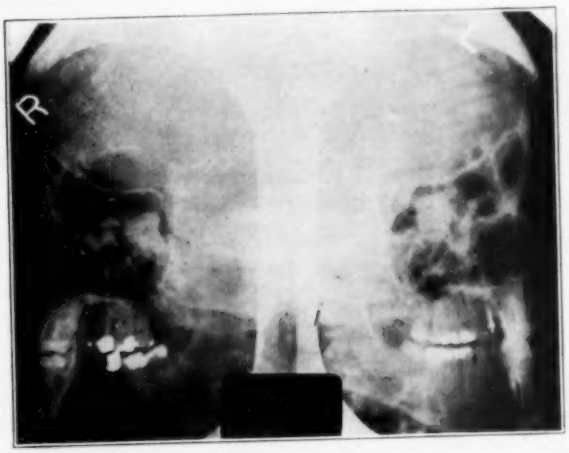

Figure 19

Figure 20

has continued to drain, notwithstanding the removal of as much of the anterior sphenoid wall as allowable. The sphenoid sinus can be seen dipping far down and back.

Figure 21 is a roentgenogram of another interesting case. The patient had a definite history of left antrum disease with an indefinite nasal discharge. Waters' position seemed to show the left antrum normal, but this oblique position exhibits an unerupted left upper third molar that was seemingly projecting into the antrum. We had overlooked the tooth in our early examination of the roentgenogram, but after several washings and an intranasal antrum operation for drainage had brought no relief, another inspection of the film revealed it. Its removal relieved the symptoms and demonstrated the root projection into the antrum. I should like to emphasize here the need of care in interpretation.

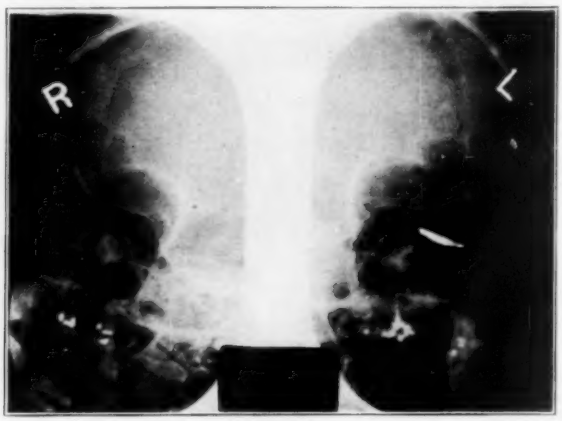

Figure 21

Figure 22 shows a chronic hyperplastic ethmoiditis and sphenoiditis of both sides, more especially of the right. It further shows beautifully the dipping down of the left sphenoid and the line of demarcation between this cavity and the posterior ethmoid cells.

This patient has not consented to operative interference, wishing to try lavage and other home treatments first. It will not only be interesting at a later date to compare a roentgenogram taken at that time, but also, if no change is apparent at the second sitting, the convincing value of the roentgenogram will be immense.

My experience has been that patients can readily appreciate the reading of a film taken in the oblique position, but seem confused when attempting to decipher the ethmosphenoidal field from the usual Waters' position.

I have had a desire to identify the sphenopalatine foramen, and this illustration (Fig. 23) shows an unusually large foramen discovered in one of the skulls.

The field was placed downward because in this particular roentgenogram we were attempting to work out relations in the antral floor.

The large round shot identifies the agger nasi, while the patch of barium paste behind the malar bone marks the sphenopalatine foramen.

So far, we have had no success in identifying the foramen in live subjects.

The next roentgenogram (Fig. 24) represents the usual Waters' position and, with the few slides that follow, is shown for comparative purposes. We use the Waters' position for the study of the maxillary and frontal sinuses.

Figure 22

The shot and wires identify the ethmoid and sphenoid, the larger shot being in the posterior ethmoid and sphenoid. This dissection was pictured obliquely and the identification of parts, especially of overlapping structures, became much easier.

The particular reason for showing this roentgenogram is to demonstrate the overlapping petrous portions on the antral fields, identified by means of the shot and wires.

Figure 25 shows the usual Waters' position again. The ethmoid sinuses are outlined with barium paste. Note the overlapping petrous portions in the lower antral field identified by strips of tin on their superior surfaces. Circular platelets of tin identify the lower portion of each antrum to indicate the degree of overlapping which in this instance is nearly one-half. This, to me, warrants the assumption that stereoscopic plates are imperative if accuracy in interpretation is to be maintained.

Figure 23

Figure 24

Figure 25

Figure 26

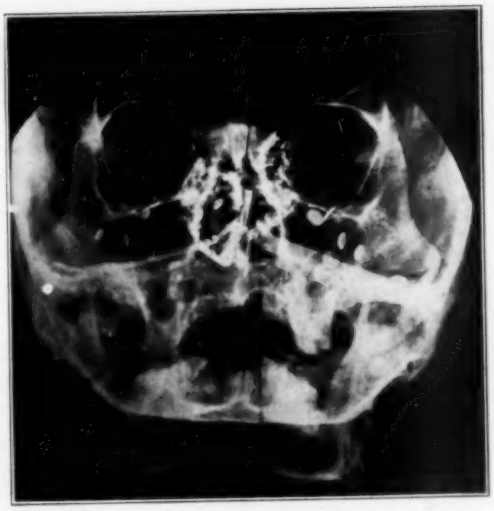

Figure 27

Do not misinterpret my thought. I have seen many roentgenograms in which the petrous block was out of the field, but an analysis of the last 200 cases shows 91 per cent. with this overlap, rendering proper interpretation difficult or impossible and emphasizing the necessity for stereoscopic pictures.

Another roentgenogram (Fig. 26) illustrates another difficulty in antrum diagnosis. The greater and lesser wings of the sphenoid in this skull were unusually thick, and though the petrous portions were materially out of the field, yet from flat roentgenograms an error in diagnosis surely would have been possible.

Figure 27 shows another usual Waters' position with a different skull, showing the overlapping petrous portions on the antral fields.

Those who do antrum surgery fully realize why the surgeon is so anxious to determine carefully the lower part of the antral field. In most instances the greatest area, and sometimes essentially the only area, of bony change is in this part of the field.

The circular piece of tin in the midline marks where the sphenoid septum should be.

This illustration is given as an additional evidence of the necessity of stereoscopic roentgenograms.

TECHNIC

I have asked Dr. Overgaard, who has done most of the roentgenographic work involved, to give details of the position, which are as follows:

Technic.—We use four 8 by 10 duplitized films which are placed with double intensifying screens mounted in cassettes. We use a 5 inch spark gap with 20 milliamperes, and a distance of 23 inches for the Waters' position and 33 inches for the oblique position.

The Waters' position is made with the patient prone on the table with a heavy pillow under the chest, chin resting on an 8 by 10 plate changer, which is raised 2 inches from the table. The nose is about 1 inch from the plate changer. The roentgen-ray tube is centered 23 inches above the head and stereoscopic views are taken.

The oblique position is made in the same manner with the patient prone, and the chest resting on a firm pillow. The head is placed so that the left side rests on the superior angle of orbit, and the prominence of the left malar bone. The tip of the nose touches the plate changer and a five-eighth inch block of wood is placed under the chin. Stereoscopic views are taken, the position is changed and the procedure repeated on the right side. The distance in this instance is 33 inches. Both right and left oblique views can be placed on an 8 by 10 film by having a

mat made with 5 inches of lead on one side and on the other an oval shape made of aluminum. This is an advantage, as both sides can be studied at the same time.

COMMENT

In my hands the oblique method of Rhese affords the best comparative study of the ethmoid and sphenoid sinuses of any methods I have tried. Most of the other positions present the individual sinus isolated from its adjacent structures or overlapped by other parts, and do not convey the comparative information so necessary for proper orientation.

LARYNGOFISSURE FOR CANCER OF THE LARYNX

REPORT OF FIFTEEN CASES *

GABRIEL TUCKER, M.D.
PHILADELPHIA

Laryngofissure, or thyrochondrotomy, for intrinsic cancer of the larynx had fallen into disrepute because it had been performed in improperly selected cases. Sir Henry Butlin (then Mr. Henry Butlin) and Sir Felix Semon, in the last decade of the last century, reestablished the operation on the sound basis on which it rests today. As established by them, it was strictly limited to small intrinsic growths; and to perform a laryngofissure when there was extrinsic involvement was considered a serious mistake. Semon, many years ago, called attention to "curious international differences" in regard to the status of laryngofissure for cancer. Strange as it may seem, this difference exists to a great extent today, so far as the United States is concerned, notwithstanding the work of Chevalier Jackson [1] and other laryngologists in this country. It is strongly advocated as the best procedure in early intrinsic cases by Sir St. Clair Thomson,[2] Mr. Herbert Tilley, Logan Turner, Adam Brown Kelly, Arthur Cheatle, Irwin Moore,[3] Sir William Milligan, and, in fact, by all prominent British laryngologists. In this country, laryngofissure is not accorded the place it deserves in the treatment of cancer. We feel that the mutilating operation of total laryngectomy is an unjustifiable operation for the removal of small, anterior, intrinsic laryngeal cancer. Dr. Fielding O. Lewis has obtained splendid results in selected cases of posterior intrinsic cancer by laryngectomy, but he does not perform laryngectomy for anterior intrinsic cases. Early diagnosis is fundamental for cure of cancer in any part of the body. In the larynx, chronic hoarseness is nearly always the first symptom; and

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* Read before the American Laryngological, Rhinological and Otological Society, Inc., May 22, 1925.

1. Jackson, Chevalier: Peroral Endoscopy and Laryngeal Surgery, Textbook, 1914; The Results of Operative Methods in the Treatment of Cancer of the Larynx, Tenth Congress International d'Otologie, Paris, July 19-22, 1922; Bronchoscopy and Esophagoscopy, Philadelphia, W. B. Saunders Company, 1922; Cancer of the Larynx, Proceedings of the American Laryngological Society, 1922.

2. Thomson, St. Clair: Two Cases of Laryngofissure for Intrinsic Cancer of the Larynx, Proc. Roy. Soc. Med., 1922-1923; Intrinsic Cancer of the Larynx, Brit. M. J. **1**:921 (June 25) 1921; Cancer of the Larynx. The Operation of Laryngofissure and Its Results in the Intrinsic Variety, Lancet **2**:163 (July 22) 1922; Diseases of the Nose and Throat, Ed. 2.

3. Moore, I.: Endo-Laryngeal Hemorrhage During or After Thyrofissure in the Removal of the Vocal Cord for Intrinsic Cancer of the Larynx. The Chief Vessel Concerned and Its Control, J. Laryngol., London **35**:326-333, 1920.

in order to make the required early diagnosis, the profession as a whole, not alone the laryngologist, must realize, as Dr. Jackson so well expresses it, "The frequently malign nature of chronic hoarseness in the adult."

DIAGNOSIS

Prior to any major procedure, laryngofissure, laryngectomy or extensive radiation, the diagnosis of cancer of the larynx should be confirmed by biopsy. The removal of the tissue can be accomplished with the utmost accuracy by direct laryngoscopy. The surgeon should have the patient's permission to proceed with the operation if cancer is found. The specimen should, as a rule, be taken from a location at the margin of the lesion, so that the normal and pathologic tissue and the intervening transition will show on examination of the specimen. We are greatly indebted to Dr. Baxter L. Crawford, of Philadelphia, for a report of very early development of malignant changes. We make it a rule to follow biopsy by immediate operation in case of positive report. We can get a report in forty-eight hours, often less, from a specimen put through the embedding process. We cannot think that metastases could have travelled far in forty-eight hours, and we have no clinical evidence of metastasis occurring in a very early case. In late cases, it seems reasonable to believe that metastasis has occurred before the specimen was taken (as in Case 9 of this series).

SELECTION OF CASE

Laryngofissure should be limited to anterior intrinsic growths when the lesion is limited to the anterior two thirds of the cord. The original classification by Krishaber into intrinsic and extrinsic cancer has been revised by Jackson by separating the intrinsic group into anterior intrinsic and posterior intrinsic, making the classification:

(1) Anterior intrinsic; (2) posterior intrinsic, or (3) extrinsic. When the growth has extended posteriorly to such an extent as to fix the crico-arytenoid joint, the percentage of cures will be less than in anterior growths; but if the involvement is still intrinsic, laryngofissure may be advisable. It is a mistake to perform a simple laryngofissure in any case in which there has been extension of intrinsic approaching the extrinsic. In such cases, the operator should be prepared to remove the arytenoid and a sufficiently wide area of normal, or, in other words, to perform a hemilaryngectomy, hemicricoarytenoidectomy or laryngectomy, as may be indicated. We must remember that extension goes beyond the apparent limits of the growth, as seen by gross appearance.

When determining the extent of the growth, mirror laryngoscopy should always be confirmed by direct laryngoscopy. The extent of subglottic extension, and the presence of ulceration, which could not

be seen by the mirror, was found in several cases of this series by means of the direct laryngoscope. In cancer anywhere, there is always extension beyond what seems to be the border of the lesion. Prior to operative procedure, either the laryngoscope or the esophageal speculum should be used to determine the presence or absence of "party wall" involvement.

TECHNIC

The technic followed in the bronchoscopic clinic is the technic developed by Chevalier Jackson. It does not differ essentially from that of the British surgeons, except that tracheotomy is not done unless it is necessary to pack the larynx for hemorrhage; intratracheal ether anesthesia is used to gain the aid of the return flow of air in keeping blood and secretions from going down into the lungs.[4]

The patient is given the usual preparation for general anesthesia; general physical examination and routine urine and blood tests, including coagulation time, are made. Nothing is given by mouth for at least six hours prior to operation. Ether anesthesia is given by the drop method until the patient is well relaxed, when the anesthesia is continued intratracheally by inserting a catheter into the trachea through the larynx, with the aid of a Jackson laryngoscope, and attaching the catheter to an Elsberg or Muller insufflation apparatus.

The patient is placed dorsally recumbent, with a sand pillow under the shoulders, with the head and neck extended. This position throws the trachea and the larynx forward, and keeping the head low prevents aspiration of secretion from the pharynx. The return flow of air passes upward around the catheter, and prevents the blood and secretions from the operative field being aspirated into the lungs.

The neck is shaved and given the usual iodin and alcohol preparation. A vertical midline incision is carried through the skin and superficial fascia from the level of the hyoid bone downward to the suprasternal notch. The deeper tissues are cut in the midline, exposing the thyroid cartilage, the cricothyroid membrane, the cricoid cartilage and the tracheal rings down to the suprasternal notch. Care is taken not to injure the perichondrium of the thyroid and cricoid cartilages, as such injury would favor necrosis of cartilage. The bleeding points are ligated.

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4. Since the foregoing was written, I have had the opportunity of seeing the after-results in patients, in whom laryngofissure was performed by Sir St. Clair Thomson with excision of a portion of the wing of the thyroid cartilage on the involved side. The results are so remarkable in the reformation of the laryngeal framework and in the very much shortened time of healing that I have modified our technic to conform to that of St. Clair Thomson, except in the minor detail of continuing to use anesthesia by catheter intratracheally through the mouth.

The manner of opening the larynx depends on the relation of the growth to the anterior commissure. If the growth is in the anterior commissure, the external perichondrium of the thyroid cartilage is incised from the notch downward to the lower border of the cartilage, and a saw is used to divide the cartilage down to the internal perichondrium. A subperichondrial dissection is then carried out by the method of Jackson (Fig. 1). The wings of the thyroid cartilage are retracted, and the growth is removed with a margin of normal mucosa at least 1 cm. in width surrounding it. If the growth does not involve the anterior commissure, the larynx is opened by making an incision across the cricothyroid membrane just above the border of the cricoid. The tip of the blade of a Jackson turbinotome is inserted through this incision, and is extended upward to the thyroid notch inside the larynx. The position of the inner blade of the turbinotome is determined by the position of the blade outside the larynx. The handle of the turbinotome is then turned slightly toward the side of the larynx that is free of growth, and the thyroid cartilage and all the tissues internal to it are divided by one clip of the turbinotome.

The growth is then removed by dissecting back the internal perichondrium from the wing of the thyroid on the affected side for a distance of at least 1 cm. beyond the margin of the growth, and the tissue is excised in one piece, the growth being removed as an island surrounded by normal mucosa. If the growth extends downward over the cricothyroid membrane, it is included in the tissue excised.

Hemorrhage is controlled by pressure and by packing temporarily with iodoform gauze, leaving, of course, an airway around the catheter for the return flow of air from the trachea. Bleeding points are ligated, suture ligatures being used if needed. All packing is removed from the larynx when the bleeding is controlled, and the wings of the thyroid are allowed to come together, but no sutures are used to close the wound in either the skin or the deeper tissues.

The wound is dressed by applying a large square of several thicknesses of gauze over the front of the neck and packing over it loosely folded gauze, pressing it down into the wound, keeping it open down to the cartilage but not between the free edges of the cartilage. This dressing is held in place by a bandage that is given a turn around each shoulder to keep the dressing in proper position. This keeps the lower portion of the wound from the cricoid downward open, so that if packing of the larynx is required for postoperative bleeding, it is necessary to cut through the tracheal rings only in order to put in a tracheotomic cannula.

The anesthetic is given so that the patient is semiconscious when leaving the table. When the patient is returned to bed, a back rest is used to elevate the head and shoulders, and as soon as consciousness returns, he is raised almost to a sitting position. Careful watch is kept for postoperative hemorrhage. Opiates are not used, either prior to or following the operation, so that the cough reflex may not be obtunded.

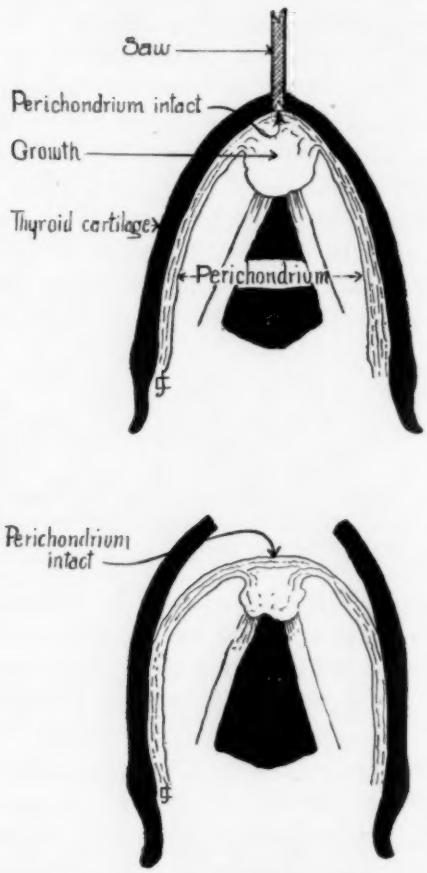

Fig. 1.—Jackson's method of subperichondrial dissection in anterior commissure growths. Procedure in cases in which the cancerous growth is in the anterior commissure. The shears are not used for fear of cutting the growth. The thyroid cartilage is sawed through without injury to the inner perichondrium which is then dissected backward safely beyond the posterior limits of the growth.

The patient is maintained in the upright position, and is allowed out of bed at the end of two or three days. This is especially necessary in elderly patients in whom pulmonary complications are to be thought of.

AFTER CARE

Packing of the external wound so that it will heal from the cartilage outward, we regard as essential. The dressings are changed at least every half hour, oftener if soiled. The interior of the larynx is not packed except for hemorrhage. Large squares of gauze are packed into the soft parts of the wound, keeping it open until the cartilages have united by fibrous union. This method prevents the larynx filling with granulations. A Rehfuss tube is placed in the esophagus, so as to give the patient abundant fluids and nourishment if difficulty in swallowing develops. This was required only once in the cases included in this report.

COMPLICATIONS

Bleeding at the time of the operation is controlled by ligature and by packing temporarily with iodoform gauze, as suggested by Dr. Lewis. When bleeding cannot be controlled by these measures, a low tracheotomy is performed, a tube is inserted, and the larynx is packed for a period of twenty-four hours. Postoperative bleeding may be controlled by the same measures; this complication occurred once in this series of cases. Dysphagia developed in one patient, requiring the wearing of a nasal feeding tube (Rehfuss) for a few days.

RESULTS

Vocal results have been uniformly good, the patient developing a usable voice usually within the first year after the operation.

POSTOPERATIVE PROPHYLACTIC RADIATION

The effect of radium on precancerous processes and vulnerable soil seems favorable when properly used. There is grave danger of overdosage, with resultant necrosis of the laryngeal cartilages. Radium or roentgen-ray treatment should be delayed until the cartilage is covered, usually from six to eight weeks after operation. The presence of perichondritis is a contraindication to radiation.

CASE REPORTS

This series of fifteen consecutive cases of laryngofissure for cancer of the larynx is from the bronchoscopic clinic of Dr. Chevalier Jackson, who saw the patients in consultation. In the case records, for the sake of brevity, there are given only the positive findings. Dyspnea, dysphagia, odynphagia, local and referred pain were not present unless so stated. The family history for cancer and tuberculosis was negative, unless stated otherwise. The past medical and social history of the patient is omitted, except when they seem to have a bearing on the case.

Any departure from the normal in the general physical examination is noted in the individual case. In all cases, to exclude tuberculosis and the presence of metastatic foci, a routine roentgen-ray examination of the neck and chest was made, and, unless there were positive findings, the results are not recorded. A blood Wassermann test, which was made in all cases, is mentioned in this series only when positive.

Case 1.—A man, aged 51, a resident of New Jersey, a silver polisher, complained of hoarseness of six months' duration. The patient consulted Dr. W. H. Deardorff, who, when examining the larynx, noted a growth on the right vocal cord and referred him to the bronchoscopic clinic. Mirror examination showed a reddish sessile growth, infiltrating the anterior third of the right

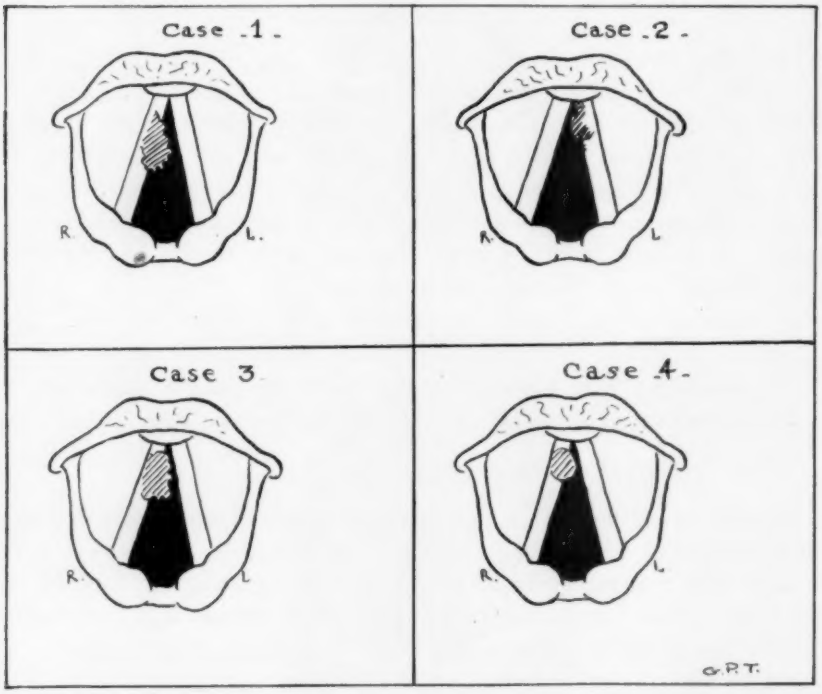

Fig. 2.—The position and extent of growth. Case 1: Sessile growth in the anterior third of right cord and ventricle. Case 2: Tumor mass in the anterior third of the cord extending to the anterior commissure. Case 3: Large granular, pedunculated mass on the anterior half of the right cord. Case 4: Circumscribed pedunculated growth on the anterior end of the right cord.

cord, and extending into the ventricle of the larynx (Fig. 2, Case 1). There was some fixation of the cord in this location. The motility of both arytenoids was good. The patient was advised to have a specimen removed for examination, and made an appointment for this purpose three days later. He failed to return at the appointed time and two weeks later, when he came back, he stated that he had consulted a laryngologist (a widely known man) who had examined his nose and throat. He had told the patient that the hoarseness was due to his diseased tonsils and disease of nose, for both of which operation

would be necessary. The patient told the laryngologist that he had been examined at the bronchoscopic clinic, and that he had been advised to have a specimen removed from a growth in his larynx for microscopic examination. The laryngologist then reexamined the patient's larynx, and told him that he had best return to the clinic to have the specimen taken from the larynx, as the tonsils and septum could wait.

On admission, direct laryngoscopy confirmed the mirror examination; the growth did not extend into the subglottic region. The specimen removed was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Under intratracheal ether anesthesia, laryngofissure was performed by the Jackson technic. A wide margin of normal tissue was removed with the growth. Convalescence was uneventful; at the end of four weeks the wound had completely closed, including the skin incision, and the patient was discharged from the hospital. A series of prophylactic radium applications was made by Dr. Henry K. Pancoast and Dr. E. P. Pendergrass during the first six months following the operation. There was no undue reaction. The larynx has been kept under observation and has remained free of recurrence. At the time of writing, three years and two months after laryngofissure, the man has a good voice; with the mirror it is difficult to tell which side of the larynx was removed by laryngofissure. The removed cord has been replaced by an adventitious one.

Case 2.—A man, aged 72, complained of hoarseness of six months' duration. One week before his admission to the bronchoscopic clinic, he consulted Dr. C. A. Thigpen, of Montgomery, Ala., who found a nodular tumor in the larynx. Dr. Thigpen confirmed his suspicion of carcinoma by biopsy, and referred the patient to Dr. Jackson.

On admission, the patient was moderately hoarse. Examination of the larynx showed a small tumor mass situated on the anterior third of the left cord on its inner surface, but not extending deeply into the subglottic tissues (Fig. 2, Case 2). The laryngeal motility was good.

Operation.—Under intratracheal anesthesia, laryngofissure was performed by the Jackson technic. The cartilage was sawed through slightly to the right of the median line, to avoid cutting through the growth which was in the anterior commissure. Subperichondrial dissection was done, removing the growth with a wide margin of normal mucosa surrounding it. There was considerable bleeding at the operation, so a tracheotomy tube was inserted through an incision in the trachea which included the second and third tracheal rings, and the larynx was packed to control the bleeding. The patient was returned to bed in good condition. Four hours later, bleeding recurred, the larynx was repacked and the hemorrhage was thus controlled. A mild degree of mental confusion was noted for two or three days after operation.

The further progress of the patient was uneventful. The cannula was removed the second day. The wound healed rapidly from below, the skin incision being kept open by packing. Against our advice, at the end of three weeks the patient left the hospital in good general condition, but the larynx was not completely healed.

After returning home, two months after the operation, acute edema of the larynx developed, probably due to granulomatous formations in the larynx, and it was necessary to replace the tracheotomy tube. Radiation was then carried out, and breathing through the larynx was reestablished. At the end of two years the patient's general condition was good, and there had been no recurrence or metastasis of the growth. A later report has not been received.

Case 3.—A man, aged 58, a life insurance agent, who had been using his voice constantly, had had a number of attacks of hoarseness over prolonged periods, the last attack beginning six months prior to admission, and patient was still hoarse to a moderate degree. The larynx showed a large, granular,

pedunculated mass involving the anterior half of the right cord (Fig. 2, Case 3). A specimen was removed by direct laryngoscopy and was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Laryngofissure was performed by the Jackson technic. Postoperative convalescence was uneventful, and prophylactic radiation was carried out by Dr. William S. Newcomet. There has been no recurrence. At the end of two years and one month, the larynx was clear and the patient developed a good voice.

CASE 4.—A man, aged 55, retired, complained of hoarseness of six weeks' duration. He was referred to Dr. Jackson by Dr. C. C. Eves, with a tentative diagnosis of laryngeal malignancy because of a small nodular growth on the

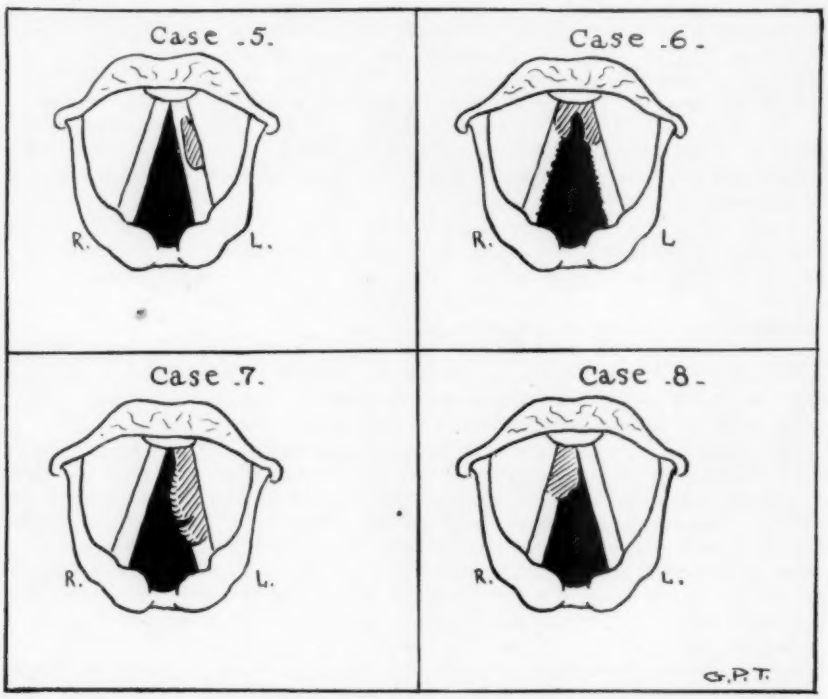

Fig. 3.—The position and extent of growth. Case 5: Ulcerative area in the middle third of the left cord. Case 6: Thickening of the right cord that extended across the anterior commissure, with the ragged appearance of both cords anteriorly. Case 7: Mass occupying the anterior two thirds of the left cord extending deeply into the left ventricle. Case 8: Mass involving the anterior half of the left cord and floor of the ventricle.

anterior third of the right cord. The remainder of the cord was slightly injected. Motility of the larynx was normal.

On direct laryngoscopy, a sharply circumscribed, pedunculated, nodular growth on the anterior end of the right cord was seen (Fig. 2, Case 4). This was removed entirely, together with the base of the surrounding normal tissue. There was also slight infiltration in the anterior commissure. The histologic examination of this specimen by Dr. Crawford showed "Squamous cell epithelioma," and this opinion was concurred in by Dr. James Ewing.

Operation.—Under intratracheal ether anesthesia, laryngofissure was performed by the Jackson technic. A large margin of surrounding normal tissue was removed with the site of the growth. The patient left the operating room in good condition, and recovery was uneventful. At the end of three weeks, the wound was almost completely healed and the patient's general condition was excellent. A series of prophylactic radium applications were made by Dr. Newcomet, beginning six weeks after the operation. There has been no suspicion of recurrence at any time following the operation. At the end of a year, there was evidence of a new cord being pulled out by the right arytenoid. Two years after the laryngofissure, the patient was in excellent physical condition and was developing a good voice. On mirror examination, the larynx shows no evidence of recurrence and very little evidence of the operative procedure.

Case 5.—A man, aged 56, had hoarseness of five months' duration. Local applications of nitrate of silver were used, probably with injurious effect, when hoarseness came on. Two weeks before admission a specimen had been taken for examination, and the report had been, "Squamous cell epithelioma." On admission, the larynx showed injection of the left cord with an ulcerative area on its middle third (Fig. 3, Case 5). Motility was normal. A specimen taken by direct laryngoscopy confirmed the previous biopsy done elsewhere.

Operation.—Under intratracheal ether anesthesia, laryngofissure was performed by the Jackson technic. The postoperative course was uneventful. Prophylactic radiation was carried out, and at the time of writing, one year and ten months later, the larynx is clear, a new cord is being pulled out, and the patient is developing a good voice.

Case 6.—A man, aged 59, had had intermittent attacks of hoarseness for extended periods during the previous eight years. Six months before admission, his tonsils were removed with a view to curing his hoarseness. Various diagnoses of his laryngeal condition had been made, among them "mycosis." He had been on prolonged vocal rest.

On admission the patient was completely aphonic. Examination of the larynx showed a peculiar ragged appearance of the edges of both vocal cords anteriorly, and a whitish deposit on the upper and lower surfaces. The anterior third of the left cord showed marked thickening which extended across the anterior commissure to the right cord (Fig. 3, Case 6). Laryngeal motility was good. A specimen was taken from the thickened area in the anterior portion of the larynx which was reported as "Squamous cell epithelioma."

Operation.—Under intratracheal ether anesthesia, laryngofissure was performed by the Jackson technic for anterior commissure points to avoid cutting through the growth (Fig. 1). An ulcerative area with raised edges, about 1 cm. in extent, was removed as a spot in the center of a mass of normal tissue. The postoperative course was uneventful. The external laryngeal wound closed and the patient was discharged from the hospital at the end of four weeks. Postoperative treatment with radium was carried out by Dr. Newcomet. Granulomas appeared in the anterior commissure at the end of the second month. Under radiation the granulomas disappeared and have not returned. At the time of writing, one year and nine months after laryngofissure, the patient has a good voice and there is no evidence of recurrence.

Case 7.—A man, aged 59, had been hoarse for seven years preceding admission, and during the last year the hoarseness had become much worse. At the time of admission he was almost aphonic. The mirror examination showed a mass occupying the left ventricle and the left cord on its anterior half. Laryngeal motility seemed unimpaired. The direct laryngoscopic examination showed that the mass occupied at least two thirds of the left cord, and extended deeply into the ventricles (Fig. 3, Case 7). A specimen removed for biopsy was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Laryngofissure by the Jackson technic was performed. The postoperative recovery was uneventful, and at the end of four weeks, the patient was discharged from the hospital; the external wound had closed from the bottom outward, and the larynx was clear. The physician who had referred the patient kept him under observation. At the end of six months, a large mass in the right side of the neck developed, and the mirror showed evidence of repullulation in the larynx. As the mass in the neck increased in size, seven months after the laryngofissure, the patient left his physician and consulted a surgeon, who did a block resection of the neck removing the mass along with the larynx. The histologic examination of the tissue of the mass as well as the tissue in the larynx showed "Squamous cell epithelioma." At the end of a year and seven months following laryngofissure, twelve months after laryngectomy, there had been no evidence of further metastasis or recurrence. The patient has gone back to his employment as a clerk and is in good general condition.

This case was deemed by us, when first seen, as on the border line between suitability for laryngofissure or for laryngectomy, because of the long duration of the hoarseness and the extent of the intrinsic involvement. The surgeon was justified in doing laryngectomy for the recurrence, and had the patient returned to the clinic, we should have advised laryngectomy.

Case 8.—A man, aged 66, an insurance agent, had been using his voice constantly. The patient first had trouble with his throat twenty-five years before admission, when a diagnosis of "smoker's throat" had been made. He stopped smoking and recovered entirely from the hoarseness. Four months before admission, the patient developed a "cold" and had "some trouble with his nose and throat." Hoarseness had begun six weeks before admission, and had become progressively worse. Dr. Charles E. Hays, of Johnstown, Pa., was consulted, and noting a lesion of the right cord referred the patient to Dr. Jackson.

On admission, the patient was moderately hoarse. The larynx showed a small mass in the anterior portion of the right ventricle (Fig. 3, Case 8) involving the anterior half of the cord and floor of the ventricle. There was slight limitation of motion of the right cord. The histologic report by Dr. Crawford of the specimen removed was "Squamous cell epithelioma."

Operation.—Laryngofissure was performed by the Jackson technic. By subperichondrial dissection, the right side of the larynx was completely eviscerated back to the vocal process of the arytenoid. The anterior half of the left side was removed by the same method. The patient's recovery following the operation was uneventful. The wound had completely healed four weeks after operation and radiation, using both the roentgen ray and radium, was begun. Following the radiation, there was considerable edema of the arytenoid, eminences and aryepiglottic folds, which persisted, causing the patient considerable annoyance for several months, and later resulting in deep fibrosis with some superficial scar tissue formation. At the end of seven months the breathing space was ample, the arytenoid motility had returned, and the patient had developed a hoarse whisper. The edema has now largely disappeared; the scar is becoming smaller. Good motility of the left cord has returned and the larynx is free from evidence of repullulation of the growth. At the time of writing, a year and a half after operation, the patient has gained 20 pounds in weight and is in very good general physical condition.

Case 9.—A man, aged 60, complained of hoarseness over a period of about a year. At first it was intermittent; for the four months prior to admission it had been continuous and had been growing progressively worse. The patient had been treated with sprays and applications of silver nitrate without favorable effect on the larynx. He consulted Dr. Lawrence Ingram, of Orlando, Fla., who found a growth in the larynx and referred him to Dr. Jackson.

On admission, the patient was moderately hoarse. On mirror examination, the larynx showed a grayish mass, having the appearance of a new growth on the upper surface of the right vocal cord, occupying the middle third (Fig. 4, Case 9). No ulceration was noted. There was no impairment of motility of the cords or arytenoids. The neck showed no adenopathy. Roentgen-ray examination of the neck and chest was negative for metastasis.

Direct laryngoscopy revealed a lesion limited to the upper surface of the right vocal cord in its middle third, with no evidence of subglottic extension. Biopsy by Dr. Crawford showed "Squamous cell epithelioma."

Operation.—Under intratracheal anesthesia, a laryngofissure was performed by the Jackson technic. Recovery following the operation was uneventful. At the end of the third week, the wound healed from the cartilage outward, the

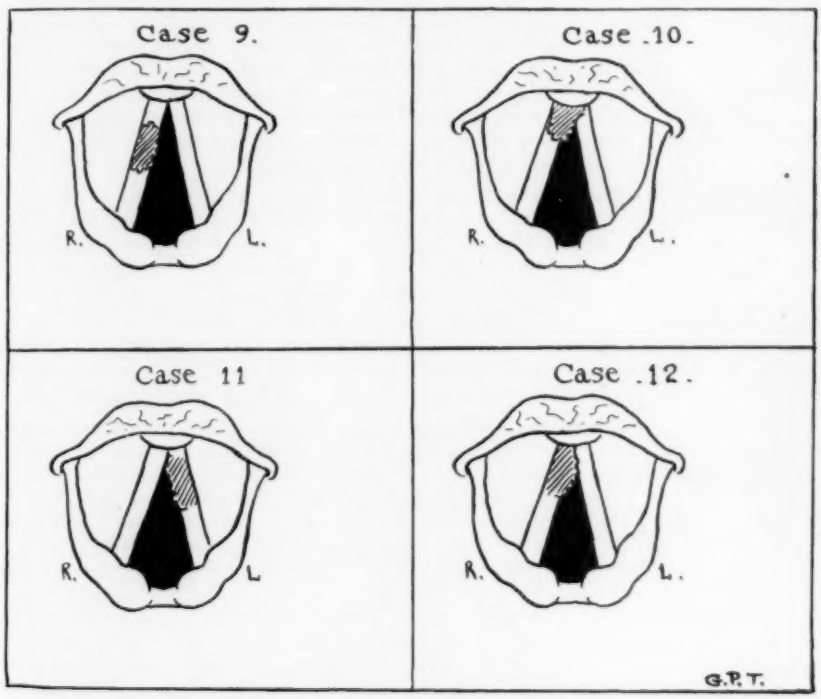

Fig. 4.—The position and extent of the growth. Case 9: Growth involving the middle third of the right cord. Case 10: Ulcerative lesions in the anterior third of the right cord. Case 11: Fungating growth on the anterior third of the left cord. Case 12: Granular thickening of the anterior half of the right cord.

skin incision being packed open with gauze. At the end of the fourth week, the patient was discharged, and returned home with instructions to return for postoperative radiation at the end of three months. On his return at the end of this time, a granulomatous mass was found at the site of the former lesion. This was removed by direct laryngoscopy, and on histologic examination was found to be "inflammatory, with no evidence of malignancy." Radiation was then carried out by Dr. Pancoast and Dr. Pendergrass, and there was no further recurrence of granuloma; only such reaction as to indicate efficient prophylactic

radiation was observed. The larynx was examined at bimonthly intervals, and was found in good condition. In January, 1925, one year following the laryngofissure, the patient had developed a loud, whispered voice, and a new cord was being pulled out of the right side of the larynx by the motion of the right arytenoid. One month later, thirteen months after the laryngofissure, the family physician, Dr. D. H. Smith, noted that a small lump had appeared in the right side of the neck, at the back of the angle of the lower jaw. This increased in size and the patient was referred again to the clinic. On examination, the mass was found deep in the neck, back of the upper end of the right sternomastoid muscle and near the angle of the jaw. A portion of this mass was removed and was found to be carcinoma. The mass was so high up and so deep in the neck that it was deemed inoperable. Examination of the larynx at this time showed it to be free of repullulation or recurrence of growth. The opinion of Dr. Jackson and other consultants in this case was that the carcinoma had metastasized prior to the laryngofissure and that the growth of the metastatic focus had been retarded by the radiation of the larynx and neck.

Laryngectomy in this case would have failed to remove the metastatic focus, because it was situated above the hyoid bone and deep in the neck close to the spine, a region that is not usually explored at laryngectomy. The growth of the metastatic mass progressed very rapidly, and the patient died from metastasis, one year and four months after the operation.

Case 10.—A man, aged 52, had hoarseness of three months' duration. Examination of the larynx on admission showed an ulcerative lesion on the right cord on its anterior third (Fig. 4, Case 10). A specimen removed by direct laryngoscopy was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Under intratracheal anesthesia, laryngofissure was performed by the Jackson technic. No complications followed the operation. The postoperative course was uneventful. Postoperative prophylactic radiation was carried out and there has been no recurrence of the growth. At the end of fourteen months, the larynx is clear and the patient is developing a good voice.

Case 11.—A man, aged 73, was born in Italy but for years had been a merchant in Lima, Peru. His chief complaint was hoarseness, which had been growing progressively worse during the five months before admission. Two years before this, the patient had developed a "cold" followed by complete loss of voice. A year later, his throat causing him some discomfort, he consulted a physician while in Italy and was told that his vocal cords were greatly thickened. The larynx had been treated with sprays by various physicians without relief. A short time before his admission to the clinic, he had consulted Dr. MacCormick of the Callo Clinic, Lima, who had made a tentative diagnosis of laryngeal malignancy, and advised the patient to see Dr. Jackson. The patient had been a very heavy smoker. The larynx showed a small granular mass on the left cord in the anterior half, but in the mirror there appeared to be no ulceration. The motility of the larynx was good. Direct laryngoscopy showed an ulcerated, fungating growth on the anterior end of the left vocal cord (Fig. 4, Case 11). A specimen, removed for biopsy, included a small portion of normal tissue so as to show the transition, brought a histologic report from Dr. Crawford of "Squamous cell epithelioma."

Operation.—Laryngofissure was performed by the Jackson technic (Fig. 1). The thyroid cartilage was separated with a saw; the left side of the larynx was eviscerated by subperichondrial dissection, which was also carried down on the right side of the anterior commissure. The postoperative condition was good, and the wound healed without any complication. The patient developed arthritis which responded to medical treatment. At the end of a month the neck was completely healed, and six weeks after operation prophylactic radiation was begun.

Six months following the operation, Dr. MacCormick reported: "The larynx is clear of any evidence of recurrence. The slight reaction due to radium

application has disappeared and the voice is improving." The improvement has continued in both voice and local appearance, and at the end of a year after the operation, the patient is in good local and general condition.

CASE 12.—A man, aged 64, a plumber, who was a heavy smoker, had hoarseness of six months' duration. He consulted Dr. Ross Hall Skillern, who examined his larynx, made a tentative diagnosis of laryngeal malignancy and referred the patient to the bronchoscopic clinic. The larynx showed a thickening of the anterior half of the right cord, granular in appearance (Fig. 4, Case 12). There was impaired mobility of this portion of the right cord, though the arytenoid motility was normal. A specimen removed by direct laryngoscopy showed "Squamous cell epithelioma," when examined by Dr. Crawford.

Operation.—Under intratracheal ether anesthesia, a laryngofissure was performed by the Jackson technic. The postoperative recovery was uneventful,

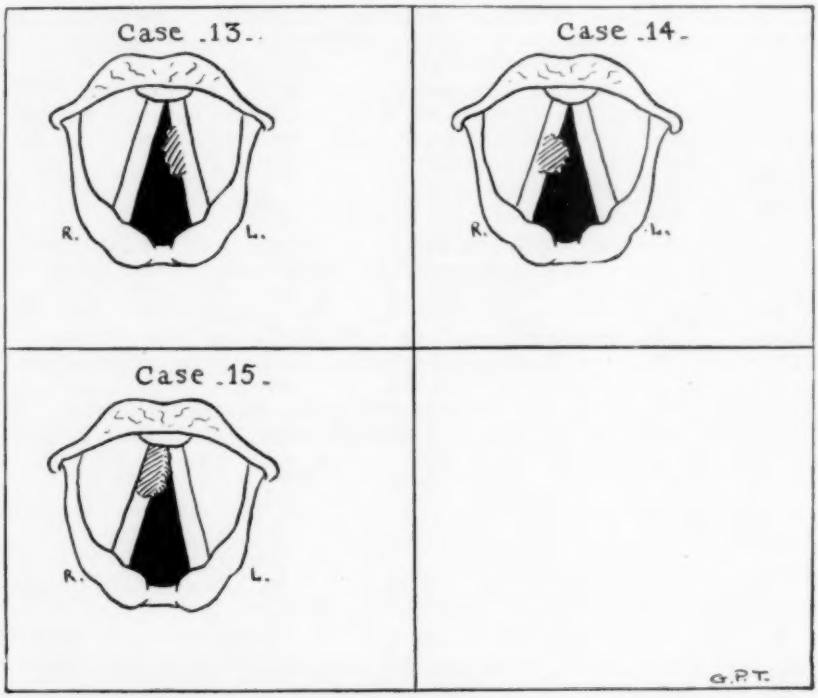

Fig. 5.—The position and extent of the growth. Case 13: An ulcerated nodular growth on the middle third of the left cord. Case 14: Growth on the upper surface of the middle third of the right cord. Case 15: Extensive involvement of the anterior third of the left cord, extending slightly subglottic.

and the patient was discharged from the hospital at the end of four weeks. Postoperative radiation was begun six weeks following the laryngofissure by Dr. Pancoast and Dr. Pendergrass. At the end of four months a small granuloma formed at the site of the former lesion. This was removed by direct laryngoscopy and was found on histologic examination to be "inflammatory tissue." There has been no recurrence of the granuloma and the larynx shows no signs of recurrence of the growth. Nine months after operation, laryngeal motility was normal and the patient is developing an excellent voice.

CASE 13.—A man, aged 68, had hoarseness of seven weeks duration. The larynx showed a small nodule on the middle third of the left cord (Fig. 5, Case 13), apparently ulcerated, and slightly impaired motility of the left cord. A specimen removed by direct laryngoscopy was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Under intratracheal anesthesia, laryngofissure was performed by the Jackson technic. The postoperative course was uneventful. At the end of four weeks the external laryngeal wound had closed. Postoperative treatment by radium was carried out. At the end of six months, a small granuloma appeared at the anterior commissure which was removed by direct laryngoscopy and was found to be "inflammatory tissue." There has been no recurrence of granuloma.

Seven months after operation, the larynx was clear, and the patient was developing a loud, whispered voice.

CASE 14.—A man, aged 54, a physician, suffered from hoarseness eight months before admission. The larynx had been treated by applications of nitrate of silver without improvement.

On admission, a routine urine examination showed 1 per cent. sugar. The general examination otherwise was negative. The larynx showed a mass that had the superficial appearance of papillomas in the middle third of the right cord (Fig. 5, Case 14). The laryngeal motility was normal.

Direct laryngoscopy showed a growth limited to the right cord, in the middle third, and not extending to the subglottic region.

Operation.—Under intratracheal anesthesia, laryngofissure was performed by the Jackson technic. There was considerable bleeding at the time of operation. A tracheotomy tube was inserted through the incision of the second and third tracheal rings, and the larynx was packed; this controlled the hemorrhage. The patient's general condition was good until the third day, when he developed marked difficulty in swallowing. The Rehfuss nasal feeding tube was introduced, and large quantities of fluids were given through it. Increased sugar was found in the urine. On the fifth day patient became very restless. In consultation with the internist, Dr. Thomas McCrae, therapeutic measures including the administration of insulin were carried out for the relief of the diabetic complications.

On the sixth day, the condition became worse; the pulse was rapid. The quantity of sugar was greatly increased; acetone was present.

On the seventh day, the patient's condition became critical. He developed bronchopneumonia with coma, and, on the seventh day following laryngofissure, he died from diabetes mellitus and bronchopneumonia.

CASE 15.—A man, aged 65, had been constantly hoarse for a year and a half. On admission, he was poorly nourished and the voice was a hoarse whisper. Examination of the larynx showed extensive involvement of the anterior third of the left vocal cord (Fig. 5, Case 15). A specimen removed by direct laryngoscopy was reported by Dr. Crawford as "Squamous cell epithelioma."

Operation.—Under intratracheal anesthesia, laryngofissure was performed by the Jackson technic. Postoperative recovery was uneventful. The patient was discharged from the hospital at the end of four weeks with the external wound completely healed. He was readmitted six weeks following the operation with the formation of granulomas in the anterior commissure. These were removed by direct laryngoscopy, and examination showed "Inflammatory tissue." Two weeks later, radiation was carried out by Dr. Newcomet; at the time of writing, two and a half months following the operation, there has been no recurrence of granuloma, and the larynx has completely epithelialized at the site of the operation.

Tabulation of Cases

Patients alive and well after three years	1
Patients alive and well after two years	3
Patients alive and well after one year	5
Patients alive and well after one year: Recurrence, metastasis, laryngectomy	1
Patients alive and well after less than one year	3
Patients died from late metastasis: No recurrence	1
Patients died one week after operation from diabetes and bronchopneumonia	1
Total operations	15

CONCLUSIONS

1. Early diagnosis is essential for cure in cancer of the larynx. In any case of hoarseness, a decision as to malignancy should be reached within two or three weeks. If the condition is operable, operation should follow immediately.

2. Laryngofissure for cancer of the larynx in early, anterior, intrinsic growths in which there are no metastases or arytenoid fixation, shows relative cures in about 85 per cent. of the cases in the statistics of Sir St. Clair Thomson, and 79 per cent. in those of Chevalier Jackson.

3. Instead of laryngectomy, the less mutilating operation of laryngofissure should always be performed in the class of cases just mentioned.

4. The patient should be observed at monthly intervals after laryngofissure, and, if there is a suspicion of recurrence, a specimen of tissue should be removed by means of the direct laryngoscope and submitted for biopsy. If malignancy is found, laryngectomy can then be done and the patient will have lost nothing by the laryngofissure, as in Case 7 of this series.

5. If the patients are properly selected, at least 80 per cent. will not require laryngectomy after laryngofissure.

6. Postoperative prophylactic irradiation by the external application of the roentgen ray and radium is useful; but should be used with great caution as to dosage because of the danger of causing perichondritis. In Case 9 of this series, the patient died of inoperable metastasis high in the neck that became evident one year after laryngofissure. That the metastasis occurred prior to laryngofissure was shown by the larynx being free of recurrence at the time of the death of the patient. It is reasonable to conclude that the postoperative radiation delayed the growth of the metastatic focus for one year.

7. The determination of the precancerous state microscopically by the pathologist, and the repeated taking of specimens of the suspicious tissue when the previous specimen is inconclusive, should give the operation of laryngofissure a higher percentage of cures in positive cases that are properly selected than in cases in which operation is done only after malignant characteristics are well advanced.

CANCER OF THE LARYNX*

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The study of the cancer problem attracts all of us. In 1924, more than 50,000 people died from this disease in England and Wales, and the numbers increase yearly by about 1,700. If we could "pluck out the heart of this mystery" (Shakespeare), we would remove one of the three greatest physical scourges of man's frail humanity, leaving him still to struggle, in this "our brittle life," with syphilis and tuberculosis. But while the latter disease is steadily diminishing both in virulence and in frequency, and while increased means of diagnosis and treatment are mitigating the terror of syphilis, yet with cancer we have made little progress in our means of diagnosis, and the surgeon's knife still remains the only certain method of eradication.

Cancer of the larynx is a particularly interesting subject of investigation. First, because certain manifestations of it yield results in the way of lasting cure which are not surpassed in any other internal organ of the body; and, secondly, because in another form laryngeal cancer is well nigh hopeless. While I have been able to publish the records of lasting cure in 80 per cent. of patients with intrinsic cancer,[1] Mackenty [2] says he questions "if extrinsic cancer will ever be amenable to surgery."

I hope to show that the favorable results in intrinsic cancer may be made still better than those I have recorded, while indicating that not all cases of extrinsic cancer are quite as hopeless as Mackenty suggests.

The difference between these extremes is not dependent on any difference of histologic structure, but appears to depend entirely on the site of origin. Hence, the value of the classification suggested by Krishaber in 1879, when he refers to "the astonishing benignity and the very slow progress of epithelioma when limited to the interior of the larynx, while the extrinsic form had a much more rapid evolution." [3]

Intrinsic cancer might as well be called "cancer of the vocal cord," for it is rare for the disease to attack any other part of the interior of the larynx. On the cord, the favorite site is the middle third or the

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*A lecture delivered at the St. Louis Hospital, Paris, May 23, 1925.

1. Thomson, St. Clair: Intrinsic Cancer of the Larynx: Operation by Laryngofissure: Lasting Cure in 80 Per Cent. of Cases, Brit. M. J. **1**:129 (Feb. 17) 1912.

2. Mackenty, J. E.: J. Laryngol. **39**:67 (Feb.) 1924.

3. Thomson, St. Clair: Cancer du larynx: Importance d'une classification, Ann. d. mal. d l'oreille, du larynx, XLI, February, 1922.

anterior half. This I was the first to demonstrate in 1921, when I showed that we had long been misled by the teaching of Virchow and Semon, who held that malignant disease favored the posterior third of the glottic surrounding.[4]

SYMPTOMS

A description of the various appearances presented by a malignant growth on the vocal cord would take too much space. I will only point out that the symptom of impaired mobility has misled us much in the past. Impaired mobility is not a necessary or a frequent symptom; it is only met with in a minority of cases; while it is valuable in distinguishing a malignant from an innocent tumor, it is of little value and may even be misleading in diagnosing a malignant growth from a tubercular syphilitic deposit; and, finally, fixation of a cord indicates a relatively advanced case and is an unfavorable symptom.[5] In forming a diagnosis, every precaution must be taken to exclude the possibility of syphilis and tubercle. The recognition of laryngeal tuberculosis, particularly in elderly subjects without pulmonary symptoms, is often difficult.

DIAGNOSIS

Finally, in the matter of diagnosis, there is the much discussed question of a biopsy. While some think that no operation should be undertaken without the confirmation of the microscope, others are of opinion that the removal of a satisfactory portion of diseased tissue is often impossible, that the pathologic report may be misleading, and that the breaking down of local resistance and the dissemination of cancer cells entailed by the punching out of a portion of the diseased tissue invites risks not otherwise compensated for.

After the intrinsic variety I would refer to the subglottic. Isambert[6] showed his wisdom when he placed this variety in a group separate from both the intrinsic and the extrinsic. In my experience it is the rarest of the three. It starts just below the anterior half of the cord. The early symptoms are slight and variable; inspection and diagnosis are difficult. Laryngofissure has sometimes been successful, but a partial or complete laryngectomy with removal of part of the cricoid cartilage may be necessary. Prognosis is not as favorable as in the true intrinsic (chordal) cancer.

Extrinsic cancer of the larynx, on the other hand, does not form as well defined a group as intrinsic. The realization of this will explain much of the difficulties and disasters which attend it.

4. Thomson, St. Clair: Intrinsic Cancer of the Larynx, Brit. M. J. **1**:921 (June 25) 1921.

5. Thomson, St. Clair: Intrinsic Cancer of the Larynx, Lancet **2**:183 (July 24) 1920.

6. Isambert: Ann. d. mal. de l'oreille, du larynx, 1876, p. 1.

Just because cancer originates from various parts of the larynx beyond its glottic border, these manifestations have all been grouped together as "extrinsic cancer." Now, as Wilfred Trotter [7] has well pointed out, this classification helped to encourage the belief that "extrinsic tumors being essentially laryngeal, could be dealt with only by extirpation of the larynx." But all such extrinsic laryngeal tumors are essentially buccal or pharyngeal in origin, and vary widely in life history from one another. Thus, growths starting from the epiglottis or the aryepiglottic fold do not tend to invade the essential parts of the larynx; are favorable conditions for surgery; can sometimes be removed without laryngectomy and lasting cure can be obtained in moderately early cases by approaching them through a lateral pharyngotomy, the voice and the natural airway being conserved. The same holds good for limited growths originating in the aryepiglottic fold either on its free margin or posterior surface.

Again, carcinoma starting in the hypopharyngeal region (postcricoid cancer), so relatively frequent in women, can sometimes satisfactorily be dealt with through the pharynx and without excising the larynx.

Of all malignant growths originating in this neighborhood, those situated in the pyriform sinus—with its lax tissue and abundant lymphatic connections—are seldom operable.

LARYNGOFISSURE

Laryngofissure, which has been so identified with the English school of laryngology, continues to claim an enduring freedom from disease in all cases of intrinsic cancer diagnosed early. The operation has a small death rate, and secures the preservation of the natural airway and a useful voice.

If the principles and details worked out in the last thirty to forty years were closely followed, I hold that this success should be universal. That it is not so at present is shown by various writers. Mackenty [8] says: "I have done a great many thyrotomies, but I have not been rewarded by the brilliant results spoken of by Dr. Thomson and others. I cannot show 70 per cent. cures. I think 20 per cent. is nearer the truth."

Schmiegelow [9] performed thirty-nine laryngofissures with seven deaths in connection with the operation.

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7. Trotter, Wilfred: The Operative Treatment of Malignant Disease of the Mouth and Pharynx, Lancet **1** (April 19-26) 1913.

8. Mackenty, J. E.: Tr. Am. Laryngol. Assoc. **41**:45, 1923.

9. Schmiegelow, E.: Hospitalstidende **63**:385 (June 23), ibid. 401 (June 30) 1920.

Fraser,[10] with fourteen cases, had three deaths from pulmonary complications following operation.

The results of my own cases have been published repeatedly. I have withheld no case. The last complete records were issued in 1922, with the final results of fifty-one patients operated on in the previous twenty-one years, together with the incidence according to age and sex, the number of patients alive and well without recurrence, the deaths of eleven patients who had died from other causes without recurrence, and the particulars of eight in whom there had been local recurrence. These results, it will be seen, give enduring cure in over 80 per cent. of cases.[11]

Let me, on this occasion, indicate my results in another way: Of fifty-five patients operated on before 1922, no less than forty of them were alive and free from recurrence three years after the operation.

Of seventy patients only two have died within forty-eight hours of the operation. The first was an alcoholic subject, to whom one sixth of a grain of heroin was given three times in twenty-four hours. He had an idiosyncrasy to that drug, developed drowsiness with contracted pupil and suppression of urine, and died in forty-eight hours. The second case was a syphilitic subject, to whom more morphine was given than was intended, namely, three-fourths grain, and he died with symptoms of septic pneumonia within forty-eight hours of the operation.

I now never give any opiate before or after the operation, and I feel sure that if my technic is carefully followed, the death rate should be nil. In cases of early diagnosis, that is, a growth limited to a vocal cord and that cord quite mobile, the cure should, with rare exceptions, be lasting in all cases and the voice should be adequate for all social necessities.

LARYNGECTOMY

Turning now to the question of laryngectomy, this mutilating operation is often looked on as the only alternative to laryngofissure. Its death rate was enormous from faulty technic. As the cases submitted to it were chiefly of the extrinsic variety, recurrences in patients who survived the operation were frequent. In recent years, the technic of the operation has been improved to such an extent that Mackenty[12] has had a series of thirty-one laryngectomies (all for intrinsic cancer) without a death following operation.

The results of the operation have also so greatly improved, chiefly because it is now employed almost entirely for the intrinsic form. In this class it should be reserved for those patients who are too far

10. Fraser, J. R.: Tr. Am. Laryngol. Assoc. **45**:223, 1923.

11. Thomson, St. Clair: Cancer of the Larynx, Lancet **2**:163 (July) 1922; Ann. d. mal. de l'oreille, du larynx (July) 1922.

12. Mackenty, J. E.: Tr. Am. Laryngol. Assoc. **44**:205, 1922.

advanced to be amenable to laryngofissure; such patients will be those in whom the disease has spread from the cord so as to invade and fix the endolarynx on the same side, or has extended posteriorly to the arytenoids, or anteriorly across the anterior commissure. It might also be necessary for the subglottic form.

Need it be pointed out that every effort should be made to secure an early diagnosis of intrinsic cancer, and for laryngologists to perfect themselves in the technic of laryngofissure? This operation leaves the patient unmutilated; able to mix with his fellows and earn his livelihood. Among my patients are business men, clergymen, lawyers and physicians. Two medical men carry on their general practice and another is a successful country surgeon. All of them play golf vigorously.

CHOICE OF OPERATION

We may hope for greater progress if we no longer limit ourselves to the choice of two set operations, on the supposition that we must either "remove the cord" or "do a complete laryngectomy!" The indications and limitations of laryngofissure I have frequently referred to. It is the operation for early intrinsic cancer of the larynx. If the disease has advanced too far, or if a recurrence takes place after it, we may succeed by means of a partial laryngectomy in securing a good voice and a partially free airway for the patient, even although he may have to wear a tracheotomy tube. Such a condition is far better than the handicap of complete extirpation of the larynx.

For cancer on the epiglottis or aryepiglottic fold, there is no need to think that "extirpation of the larynx" is the only possibility. It is not likely to be more successful than removal of the disease through a lateral laryngotomy, leaving the endolarynx practically intact.

For retrocricoid cancer, it is possible to succeed through a lateral pharyngotomy.

For cancer originating in the sinus pyriformis, at present there is not any possible method of extirpation by operation.

In all of these operations we should proceed by the open method. A tracheotomy should always be done. By it, the great danger of pneumonia can be guarded against. Such fancy operations as "window resection" are opposed to the principles of surgery, which demand the fullest exposure possible, the approach to the malignant growth being from the front, with the growth centrally placed in the part removed and with as wide a margin as can be secured.

CONCLUSIONS

Removal should be planned in regard to the location of the disease and not in reference to the removal of an organ. When the disease

is intrinsic (that is, on a vocal cord), the unfailing symptom of persistent hoarseness should bring the patient to a laryngologist while it is limited in extent. Early diagnosis should lead to laryngofissure, an operation which should be free from danger to life and should be followed by an adequate voice and lasting cure. If patients come late, if diagnosis is delayed, or if local recurrence takes place, we may still secure success by a partial laryngectomy. Extrinsic cancer is seldom operable. When it is, the cancer can be removed through a lateral pharyngotomy. A complete laryngectomy is rarely helpful in extrinsic disease. It is an operation occasionally indicated for neglected and extensive intrinsic cancer. As such cases will become rarer with progress in the education of the public and the training of the laryngologist, so will laryngectomy become a less frequent operation while laryngofissure will be more frequently and successfully performed.

THE MODIFIED RADICAL MASTOID OPERATION IN THE TREATMENT OF SUBACUTE MASTOIDITIS

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The use to which I have put this operation may appear radical to some, particularly to those who do not favor any deviation from our time honored methods of procedure, but in defense of its practicability and results obtained, which in the end is our object, I can point to twenty-two operations by this method with perfect results in every case.

Every ear surgeon meets with those conditions that, owing to prolonged affection of the middle ear, prevent healing of the mastoid cavity after simple mastoidectomy, or rather the mastoid cavity must be kept open to allow drainage of the discharge which has become foul from the middle ear, necessitating long period dressings, finally wearing both the patient and the surgeon down. This is the subacute or recent chronic otitis media suppurativa with mastoid complications.

It does not matter how these dressings are carried out or whether no dressings are employed at all after the first dressing, or whether the mastoid antrum is not touched during the operation, the result is the same, a very laborious period of prolonged dressings, with finally in a large percentage of cases renewed curettage of the granulations in the mastoid cavity.

It is now my method in those patients in whom a mastoid has developed after the ear has been discharging over two months and the discharge become foul, to perform the modified radical mastoidectomy as done by Heath, with the exception of the flap, which is handled differently as will be explained later. In three weeks, on an average, healing has taken place in what otherwise would have been a long and arduous series of treatments.

Another class of cases to which this operation is applicable is that of sclerosis of the mastoid bone. Here there is never complete filling of the mastoid cavity after exenteration, and recurrence of mastoiditis is frequent. Each cold endangers the mastoid.

By the modified radical operation these recurrences are prevented, since the opening into the mastoid antrum communicates with the canal after this operation is performed, unless the mastoid cavity has completely filled in, when there is no danger of a recurrence. The danger of a recurrent mastoid infection is nil when the cavity has completely filled with bone. The danger is real when the cavity has filled with soft tissue which has become organized into a soft mass of fibrous tissue, waiting

to be broken down by the first invading organisms. This is what happens in a great many mastoidectomies, as is well known, and often a cavity is found which has not filled with tissue of any description.

Still another type of case is that of long standing otitis media purulenta, of several years duration, with intermittent cessation of the discharge or dry periods of short duration. Here the discharge is foul, as a rule, and healing of the mastoid cavity is prevented after operation, the same as for the subacute cases already described.

TECHNIC OF OPERATION

The operation as I perform it is simply an exenteration of the mastoid and the taking down of the posterior meatal wall as far as the tympanic ring; the ossicles are not exposed. A flap simply of two horizontal incisions is made in the membranous meatal wall, the flap is shaved down thin, folded back on itself and stitched to the anterior lip of the mastoid incision. It is not necessary to extend the incision into the cartilaginous portion of the ear.

After the flap is sutured in place the mastoid is packed with plain gauze and the end brought out through the meatus, when the mastoid incision is closed entirely. If the ear has been discharging profusely before operation, a small wick should be left for a few days in the inferior angle of the mastoid wound to facilitate drainage, after which it can be removed.

When the incision is extended into the cartilage of the ear in making the flap, the danger of a perichondritis developing is real, and for that reason alone it is not recommended to include the cartilage in the flap incision. This complication is rare, but its danger is to be borne in mind as when it does occur a deformity is left, although the Jansen method of early excision of a segment of cartilage from the auricle will, as a rule, retard the process.

One of my patients developed this complication but I laid it to a very debilitated condition. After operation this patient gained 20 pounds (9 kg.)

I have always employed plain gauze for packing after a mastoidectomy (except when the dura or sinus is exposed), as I believe that iodoform gauze is irritating and that this irritation is at the bottom of erysipelas when it occurs as a complication. This was strikingly emphasized in Dr. Jansen's clinic in Berlin when I was house officer there. A considerable number of cases of erysipelas were developing after mastoidectomy, and the cause could not be determined. Finally the use of Swiss army gauze which had been employed as packing was discontinued and the erysipelas ceased, although no organisms were discovered on the gauze.

After complete healing has taken place, in the majority of cases the mastoid cavity is filled with solid bone, leaving a wide meatus with the posterior wall smooth, so that it is impossible to determine whether a flap operation has been performed. In some cases a cavity is left when the mastoid has not refilled, and then there is direct communication between the meatus and the mastoid antrum. No trouble is experienced with granulations forming.

COMMENT

The first packing is allowed to remain three or four days when no further packing is required. It is my custom to fill the cavity through the meatus every second day with 1 : 500 acriflavin solution, previously cleansing the canal.

If this method is followed out on selected cases, many would be saved from a radical operation although I do not recommend it for chronic suppuration. Later complications, such as sigmoidal sinusitis and meningitis, would often be prevented, as these complications are often secondary to a mastoidectomy when the cavity has not completely refilled and the external wound is allowed to heal too soon.

MENINGITIS SYMPATHICA*

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Acute suppurative conditions, either in the accessory sinuses of the cranium or in the ear and its related structures, and in the brain, very frequently cause a reaction in the cerebrospinal fluid. This reaction is characterized by: (1) an increase in the amount of the fluid; (2) an increase in the albumin content, which may be moderate or considerable; (3) pleocytosis, in which generally there is an increase of polymorphonuclear leukocytes, but occasionally an increase in the number of lymphocytes; (4) turbidity of the fluid. These changes in the cerebrospinal fluid may be associated with the symptoms of meningitis, such as rigidity of the neck and the presence of Kernig's symptom. This reaction has received the name of meningitis sympathica by Plaut, Rehm and Schottmüller.[1] The most frequent etiologic factor is inflammation of the ear, with or without mastoid sinus or labyrinth involvement, and in these conditions the presence of this syndrome is of great importance both from the point of view of the diagnosis and also of therapy.

The following cases are cited as illustrations of different otitic pathologic processes which may cause reaction in the spinal fluid.

REPORT OF CASES

CASE 1.—*Meningitis sympathica in a case of otitis media without clinical signs of mastoiditis.*

S. R., aged 10, was admitted to the otologic service of Dr. I. Friesner at the Mt. Sinai Hospital on May 4, complaining of pain in the right ear, with discharge, for three days. This was preceded for two weeks by infection of the upper respiratory tract. Physical examination on admission revealed a rigid neck, bilateral Kernig sign, and positive Brudzinski sign.

May 4, before operation, 5 c.c. of slightly turbid fluid under increased pressure was removed, which contained 1,100 cells per cubic millimeter, of which 85 were polymorphonuclear leukocytes, and no bacteria. There was a slight amount of pus in the mastoid cells, and an area of the dura the size of a nickel was exposed, which appeared yellowish, gray and thickened.

May 7, the temperature became lower, the Kernig sign and rigidity disappeared; the child was discharged on May 26 as cured.

CASE 2.—*Old otitis media with no clinical signs of mastoiditis but a thrombosis of the lateral sinus giving rise to symptoms of meningitis sympathica.*

S. G., a boy, aged 11 years, was admitted April 7, 1924, with a diagnosis of mastoiditis on the left side, with meningitis and septicemia as complications. A year previously, following a cold, the ear was opened by a physician. The patient experienced no difficulty with the ear up to two months before admission, when, because of acute otitis, the ear was incised and discharged freely. The discharge

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* Read before the Association for Research in Mental and Nervous Diseases, December, 1924.

1. Plaut, Rehm, and Schottmüller: Leitfaden zur Untersuchung der Zerebrospinalflüssigkeit, Jena, Fischer, 1913.

ceased up to two weeks before admission, when fever developed and the ear was again incised. There was little drainage up to the day of admission, when the child began again to complain of headache but no pain in or behind the ear.

Physical examination revealed that the eyes were negative; a moderate rigidity of neck and retraction of head; a positive Brudzinski sign, a suggestion of a bilateral Kernig sign, and no Babinski, Gordon or Oppenheim signs. The temperature was 104 F. The preliminary diagnosis was acute meningitis. Dr. Friesner stated then that there were no signs of mastoiditis.

On the day of admission the blood count was: white blood cells, 21,000; polymorphonuclear neutrophils, 92; lymphocytes, 8. The lumbar puncture yielded 35 c.c. of cloudy fluid containing 2,000 cells per cubic millimeter; albumin, 4 mm. ring; globulin was increased; no tubercle bacilli or other bacteria were seen in direct smears or cultures. Ninety of the cells were of polymorphonuclear type, and 10 were lymphocytes.

Operation.—On April 8, the left mastoid was exposed, but no inflammation was found; the dura was then exposed both in the middle and posterior fossa but no pathologic process was seen. The sinus was exposed and a thrombosis was discovered. The jugular vein was ligated. The same day lumbar puncture yielded 40 c.c. of cloudy spinal fluid; 13,440 cells per cubic millimeter; 95 polymorphonuclear cells; 5 lymphocytes; albumin, 5 mm. ring; globulin was increased. The Wassermann test was negative. Direct smears showed many pus cells and no bacteria.

Course.—April 9, the blood culture taken before the operation was reported to be negative. April 10, Dr. Baily reported that the pupils were normal, and there were no extraocular palsies. The visual fields were normal; both disks were hyperemic, the details were blurred and the margins were obscured; the retinal veins were dilated and tortuous. The diagnosis was beginning optic neuritis.

April 12, white blood cells, 14,000; polymorphonuclear neutrophils, 82; lymphocytes, 18; cells counted, 100. April 13, by spinal puncture 20 c.c. of clear fluid, under moderately increased pressure, was removed. The boy was discharged improved on April 28. Subsequently he was readmitted to the hospital, a radical mastoid operation was done on the left ear and a choleasteatoma was removed. The patient was then discharged cured.

Case 3.—*Meningitis sympathica in a youth who had not only been operated on for acute mastoiditis and sinus thrombosis, but in whom infection of both lateral sinuses had persisted despite the operation, with persistence of meningitis sympathica but without the development of an acute operative meningitis.*

W. B., aged 21, admitted to the otologic service of Dr. Friesner at the Mt. Sinai Hospital, May 18, 1922, had been suffering with headaches for months. He had been operated on for acute mastoiditis at the Norwegian Hospital on Nov. 10, 1921, and for sinus thrombosis on November 17. He recovered from both operations, but at intervals of from a few days to a week, had attacks of pain in the head, with a temperature from 103 to 105 F., sweating and prostration. The spinal fluid on many occasions was clear; there was no increased pressure. The culture was sterile. There were from 14 to 17 cells per cubic millimeter.

On admission, examination revealed rigid neck, bilateral choked disk and a moderate bilateral Kernig sign. Under increased pressure, 10 c.c. of spinal fluid was removed, which was clear and contained 1 lymphocyte.

May 19, an exploration of the left mastoid and temporosphenoidal area proved negative. May 24, 10 c.c. of clear spinal fluid, under slightly increased pressure was found to contain 150 cells, mostly lymphocytes.

The patient steadily grew worse, with irregular temperature. The pulse was rapid and of poor quality. He was drowsy most of the time, also irrational, and died June 3.

Necropsy revealed no evidence of meningitis. Both lateral sinuses at the tentorium were filled with pus—the sinuses communicated with one another.

CASE 4.—*Meningitis sympathica with both mastoiditis and labyrinthitis.*

The marked meningeal reaction in this case was unquestionably due to labyrinthitis. In this type of case, unless operated on, the patient almost invariably dies from acute suppurative meningitis, self imposed on the meningitis sympathica. In many cases acute suppurative meningitis develops before there is an opportunity to operate. The most favorable time for operation is when the acute process has subsided. Even then there is danger of an acute suppurative meningitis following the operative procedure, in subacute or chronic cases.

A. H., a woman, aged 26, admitted to the otologic service of Dr. Friesner at the Mt. Sinai Hospital Jan. 29, 1922, had complained of pain in the left ear for four days, and of discharge for one month. Two weeks before admission she had attacks of vomiting, staggering and dizziness.

Examination on the day of admission revealed a granuloma springing from Shrapnell's membrane. Occasional rotatory nystagmus occurred on looking to the right, but there were no other neurologic signs. Five cubic centimeters of turbid spinal fluid was removed under increased pressure, which contained 4,400 cells per cubic millimeter, 90 of which were polymorphonuclear leukocytes.

January 30, total deafness of the left ear developed. There was no caloric reaction. Definite rigidity of the neck and a bilateral Kernig sign were present. Spinal fluid was removed under increased pressure, and contained 6,400 cells per cubic millimeter, 90 of which were polymorphonuclear cells; no bacteria were found in cultures.

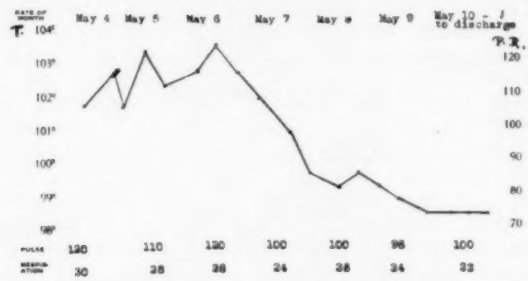

Chart 1.—Temperature of a patient with otitis media.

January 31, the same quantity of fluid was removed, and 1,060 cells per cubic millimeter was found, 90 of which were of polymorphonuclear type; no bacteria were found in cultures.

February 4, there was paresis of the upper branches of the left facial nerve, and the fluid showed 1,200 cells per cubic millimeter, many lymphocytes and no bacteria. February 13, a radical mastoid operation and labyrinthectomy were performed. February 17, the facial paresis was almost gone, and the patient was discharged as cured on February 24.

CASE 5.—*Meningitis sympathica with inflammation of the mastoid, perisinous abscess, and also epidural and temporal lobe abscess.*

Despite operation, this patient developed an acute suppurative meningitis. The presence of meningitis sympathica indicated to the surgeon the possibility of an intracranial complication and prompted exploration of the cranial cavity.

I. M., a boy, aged 10, admitted to the otologic service of Dr. Friesner at the Mt. Sinai Hospital, May 31, 1923, had had a chronic ear complaint for two years. For three days he had had pain in the right ear. On the morning of admission he had a chill, felt drowsy, was stuporous, did not respond to questions and started vomiting. His neck was rigid; a bilateral Kernig and a right Babinski sign were present; the left pupil reacted more than the right. Spinal puncture, under increased pressure, removed 10 c.c. of cloudy fluid, containing 3,500 cells per cubic millimeter, all of polymorphonuclear type, and no bacteria.

June 1, there were 4,000 cells per cubic millimeter, mostly of polymorphonuclear type, and no organisms. There was no caloric response. June 2, 5 c.c. of spinal fluid, removed under slightly elevated pressure, contained 4,400 cells per cubic millimeter, mostly of polymorphonuclear type, and no bacteria. June 4, 5 c.c. of clear fluid was obtained with 220 lymphocytes but no bacteria.

At operation on June 5, a mastoiditis and perisinous abscess were found. The pus in the mastoid cells was foul. There was an epidural abscess in the floor of the middle fossa, communicating with a large temporal lobe abscess.

June 9, there was neck rigidity and the Kernig sign was somewhat diminished. June 19, the neck rigidity and the Kernig sign were more marked, and the fluid showed 4,000 lymphocytes, but no bacteria. June 24, the fluid showed 1,500 lymphocytes, under increased pressure; gram-positive cocci were present in both smears and culture.

June 28, the fluid, under increased pressure, showed 1,200 lymphocytes, with gram-positive cocci present in both smears and culture. June 29, the patient died.

CASE 6.—*Meningitis with the focus of infection in a chronic ear and mastoid inflammation.*

The inflammation of the ear and the mastoid cells had resulted in the development of an abscess, and the reaction of the spinal fluid indicated the presence of an intracranial complication demanding interference. Unquestionably, had the

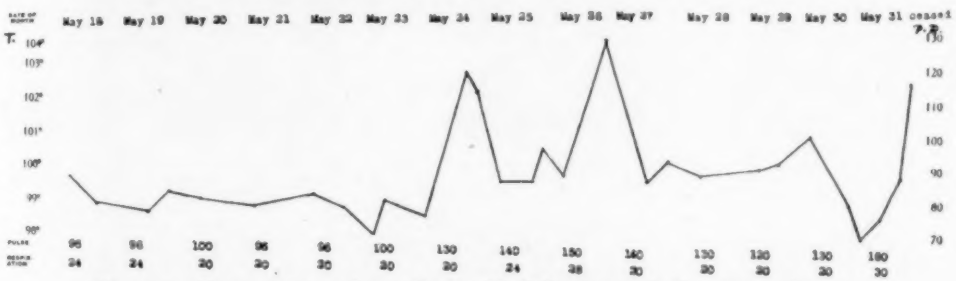

Chart 2.—Temperature of a patient with infection of both lateral sinuses.

spinal fluid been examined earlier in the course of the disease, changes in this fluid would have been noted and earlier operative interference undertaken. The result might have been more favorable.

The patient was admitted to the otologic service Nov. 8, 1918, with the complaint that five weeks before admission, following the removal of a polyp from the right ear, severe pain on the right side of the head developed, with a continuous temperature of 104 F. The patient appeared septic, complained of dizziness on attempting to stand, and also vomited several times.

Physical examination revealed a slight right facial weakness, marked nystagmus to the right, moderate nystagmus to the left, bradycardia, and marked adiadokokinesis.

November 9, Dr. K. Schlivek reported the optic nerve heads as red with veins slightly engorged, but the fundi otherwise negative.

November 10, Dr. S. Oppenheimer performed an exploratory mastoidectomy, exploratory craniotomy and decompression. The mastoid showed ivory-like hardness with complete obliteration of the mastoid cells. No exudation existed about the sinus, nor on the dura of the temporal fossa. The antrum of the ear was large and filled with pus. The squamous portion of the temporal bone was denuded, and the dura was exposed over an area 1½ inch in diameter; pressure was markedly increased, but the dura was clean with no exudation. Lumbar puncture, under moderately increased pressure, produced clear fluid, with 300 cells, 80 of which were mononuclear and the remainder polymorphonuclear; smears and cultures were negative; the albumin ring was 4 mm.

November 11, Dr. Schlivek reported a slight bilateral papilledema, and on the same day Dr. Oppenheimer performed a craniotomy with drainage. The skull and

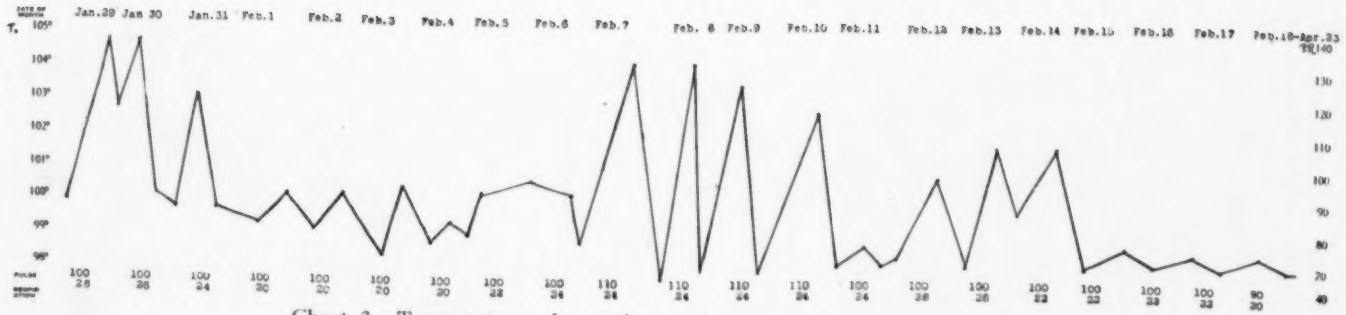

Chart 3.—Temperature of a patient with both mastoiditis and labyrinthitis.

dura were opened over the cerebellum; a grooved director located an abscess cavity in the cerebellum, which was drained. Smears from the pus showed the presence of gram-positive cocci; cultures yielded *Staphylococcus aureus*. The patient died on the night of the second operation.

Comment.—It frequently happens in cases of acute otitis that either while the acute process is still present or after it has subsided, and even the perforation of the tympanum has healed, symptoms of meningitis develop. A lumbar puncture at this time shows increase in pressure of the spinal fluid and the presence of a large number of polymorphonuclear leukocytes. When examined both by culture or by smears, this fluid appeared to contain no bacteria. A number of days may elapse during which the symptoms of meningitis persist and are aggravated, and yet no bacteria are found in the spinal fluid after repeated examination.

Finally, a day or two before death, which is the usual outcome of a case of this kind, bacterial growth is obtained. Cases such as this are not to be regarded as meningitis sympathica, but as instances in which, for some reason as yet unknown, bacteria cannot be demonstrated in the spinal fluid. It is possible that the organisms are present in the meninges, but not freely in the fluid, and that the few that do enter the fluid are disintegrated by bactericidal action, and that a period elapses until the organisms become so abundant that the bactericidal power of the cells lining the subarachnoid space is unable to cope with the invasion, and the germs can then be demonstrated. These cases must be regarded from the onset as cases of acute meningitis, and have not the significance of meningitis sympathica.

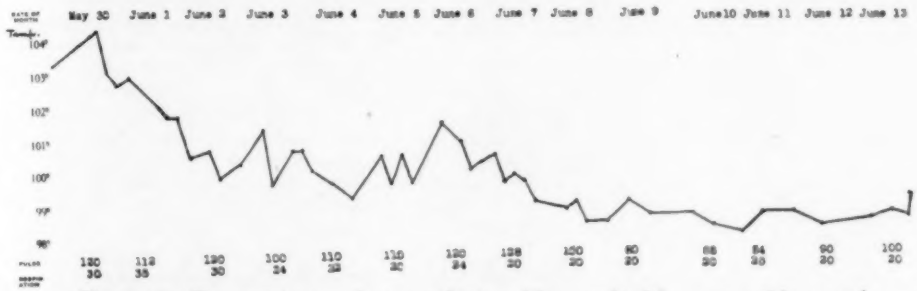

Chart 4.—Temperature of a patient with meningitis sympathica and complications. (Left.)

Meningitis sympathica occurs when there is a brain abscess, and, whether such an abscess is associated with an inflammation of otitic or accessory sinus origin, it is always a symptom of grave portent. It is an indication that the inflammatory focus is not under control, and unless this focus is adequately attacked, acute meningitis is certain to intravene, or in a case of brain abscess the patient will succumb to the inflammatory process. In illustration of this, I wish to cite a case which has already been reported.[2]

CASE 7.—A man, suffering from orbital cellulitis of nine days' duration, was admitted to the service of Dr. Elsberg, Nov. 29, 1913. The orbital tissues were incised and drained. The next day lumbar puncture yielded 15 c.c. of turbid spinal fluid under tension; the cells were increased and all were polymorphonuclears. The fluid contained *Staphylococcus albus* due to contamination. This finding means that there was a meningitis sympathica and that the inflammatory process or a toxin had reached the meninges.

The patient improved considerably after the operation, and yet irritation of the meninges warned against a too hopeful prognosis. Thirteen days following the operation, although the patient was doing well, I requested another lumbar puncture, and slightly turbid fluid under a pressure of 160 mm. was obtained. It

2. Strauss, I.: Am. J. M. Sc. **154**:748 (Nov.) 1917.

contained 133 cells per cubic millimeter, with a greater proportion of mononuclear than polymorphonuclear leukocytes. The albumin content was increased. Cultures were sterile. These findings were a positive indication that the patient was not out of danger.

The patient left the hospital, apparently cured, Dec. 30, 1913. March 10, 1914 (three months after discharge), the man was readmitted because of severe headaches in the right temporal region. No evidence of accessory sinus disease was found. The eye examination gave negative results. Lumbar puncture yielded clear fluid under increased tension, without increase of cells. The patient was discharged with the diagnosis of periostitis of the frontal bone.

June 25 (three months after the second discharge), the man was readmitted because of severe headache in the same region as previously, with drowsiness and vomiting—symptoms of intracranial pressure. After admission, he had a convulsion. Lumbar puncture yielded fluid under pressure with increased albumin content, increase of polymorphonuclear leukocytes, and no bacteria. This was evidence of renewed meningeal irritation. An operation was performed and the frontal lobe was exposed; it appeared soft and the pia over it was edematous, but no abscess was found. August 20, the man was discharged, improved.

This patient was subsequently admitted to another hospital, where repeated lumbar puncture yielded sterile, turbid spinal fluid. A diagnosis of brain abscess in the right frontal lobe was made and the lobe explored, but without result. Necropsy revealed an abscess in the lobe.

Another case of similar nature, also previously reported by me, is cited to show that meningitis sympathica may persist for a long time in the presence

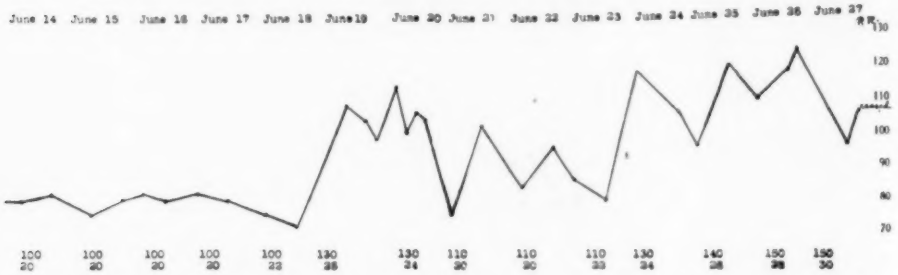

Chart 4.—Temperature of a patient with meningitis sympathica and complications. (Right.)

of a nonsuppurative intracranial focus which has been operated on. There is then evidence of the presence of another focus which has not as yet been localized. In the case cited this focus finally caused the development of acute suppurative meningitis and death. It was situated at the apex of the petrous portion of the temporal bone, a location which unfortunately cannot be reached by surgical measure.

Case 8.—M. G., a man, admitted to hospital Aug. 12, 1908, had had pain in the right ear four years before. The drum was incised, and the ear discharged pus for three months. Six weeks before admission the man had gangrenous appendicitis. Eight days before admission he had profuse discharge from the right ear. Two days later he had severe headache, his temperature was 102 F., he was prostrated and vomited several times. Marked rigidity of the neck was present with herpes labialis, but there was no chill or pain over the mastoid.

Physical examination revealed no tenderness or swelling over the mastoids; the knee jerks were exaggerated but there was no clonus or Babinski sign. The neck was rigid; Kernig's sign was marked. The symptoms pointed to meningitis which did not appear to be of the ordinary cerebrospinal type. The ear was regarded as the probable cause. Lumbar puncture yielded 25 c.c. of turbid fluid under markedly increased tension. Polymorphonuclear cells constituted 80 per cent. of the cells; no bacteria were found. Aseptic polymorphonuclear meningitis was diagnosed and operation for brain abscess was advised.

On August 13, at the operation performed by Dr. Wolff, the right mastoid cells were found practically sclerosed. The antrum was exposed and found filled with a mass of cholesteatomatous material, as was also the middle ear. The sinus was normal. The dura was found pulsating, and there were no epidural abscesses. It was not considered advisable to aspirate the brain at this time.

On August 14, the pulse varied from 72 to 80; headache was present, and there was less pain over the right ear. There was a right facial palsy. The cerebrospinal fluid contained 85 per cent. polymorphonuclear leukocytes. On August 15, the patient was better with much less headache, less rigidity of the neck and Kernig's sign was less marked.

On August 19, some edema of the eyelids was present, especially the lower. The eyegrounds showed edema; there was infiltration of both retina, especially on the left side; the retinal vessels were raised and the structure of the retina was blurred.

On August 22, Dr. Friedenberg reported that the pupils were dilated, the right disk was slightly hazy, the veins were tortuous, the retina near the disk was slightly edematous and there was slight pallor of the temporal half of the disk.

On September 6, a profuse discharge was present from the mastoid; since operation the temperature varied from 99 to 102 F. The patient had a rigid neck and Kernig's sign was present. The profuse discharge continued and the packing was removed on September 12, when rigidity of the neck and Kernig's sign were not so marked. On September 20, lumbar puncture produced cloudy fluid containing 71 per cent. polymorphonuclear cells. On September 22, the meningitis symptoms were still marked. Lumbar puncture yielded 25 c.c. of turbid fluid with 85 per cent. polymorphonuclear cells. After each puncture the patient's symptoms were temporarily relieved.

On September 24, the symptoms were still present and the patient was worse; the temperature was 103 F. and the pulse 80. Exploratory craniotomy was performed by Dr. Oppenheimer. The dura was under marked tension; no pus or purulent cerebrospinal fluid escaped. With a scalpel, punctures of the brain were made in four or five directions, but each time with a negative result. On September 26, following the operation, the symptoms were more marked and the patient became delirious. Lumbar puncture yielded fluid under tension which was almost pure pus. The condition was relieved after lumbar puncture and the patient became rational for a short time.

The first samples of cerebrospinal fluid contained no bacteria; when the patient became very sick the fluid contained bacteria microscopically, but they did not grow in culture. After the operation pure pus was found; it was considered probable that a brain abscess had ruptured.

Necropsy.—At the apex of the petrous portion of the temporal bone was an area of caries and necrosis. The pus was foul, thick and greenish. It contained a variety of bacteria, most of them gram-positive bacilli. No abscess was found anywhere in the brain, but the presence of practically pure pus in the cerebrospinal canal shortly before death shows that an abscess, which was probably present previously, had ruptured into the ventricle. The patient evidently had three attacks of so-called "meningitis sympathica." These were probably due to infection of the canal by anaerobic bacilli, which did not multiply sufficiently to cause progressive meningitis.

Comment.—Meningitis sympathica may also be present in a patient in whom there is an inflammation of the accessory sinuses of the cranium or even in the structures adjacent to it.

Meningitis sympathica must be differentiated from tuberculous meningitis, from the so-called aseptic meningitis, which is probably a meningitis caused by an unknown focus and therefore the same significance as meningitis sympathica, and from the reaction of the spinal fluid in poliomyelitis and encephalitis. This differentiation cannot always be made, except in the case of tuberculous meningitis, from a study of the fluid itself, but must be made from the other clinical symptoms and the course of the disease.

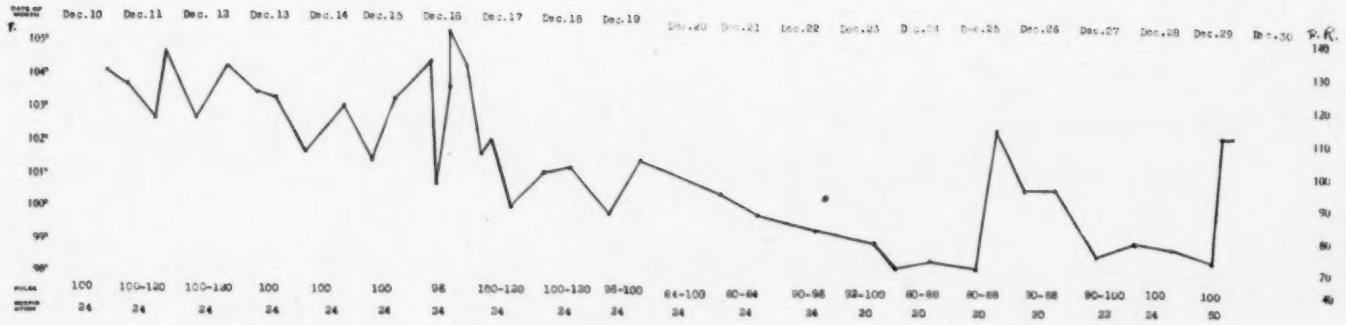

Chart 5.—Temperature of a patient with chronic inflammation of the middle ear and mastoid.

CASE 9.—*Chronic inflammation of the middle ear and mastoid with an acute exacerbation.*

On the second day after the patient's admission to hospital, there was evidence of a beginning irritative process of the meninges shown by increased pressure of the spinal fluid and the presence of 20 lymphocytes. For five days thereafter no extension of this irritation was noted, then a lumbar puncture was made, and a well-advanced meningitis sympathica was found to be present. The analysis of the case indicates that the inflammatory process attacked not only the mastoids but the sinuses and the perisinous tissue, and then advanced intracranially with the production of a large abscess in the cerebellum. During all this period, the meningitis sympathica was indicative of intracranial complication, and a number of days supervened before a bacterial meningitis made its appearance. It is interesting to note that the blood culture in this case showed a bacteremia before organisms could be demonstrated in the spinal fluid. The signs of cerebellum involvement in this case were extremely slight, and it is a question whether this abscess in the cerebellum had not existed for a number of days previous to the admission of the patient to the hospital and even before meningitis sympathica was present. There is no method, however, of proving this point. The patient could not be operated on when the meningitis sympathica was discovered because of the presence of erysipelas.

A. N., a woman, aged 51, was admitted to the otologic service of Dr. Friesner at the Mt. Sinai Hospital on Dec. 10, 1924, complaining of left hemicrania for the past twelve days. For two years she had had a persistent foul discharge from her left ear, and for twelve days before admission the discharge was profuse. The left ear became red, tender and swollen on the day before admission. The patient also stated that she had a distinct chill the day before admission. There was no vertigo, vomiting or tinnitus.

Physical examination revealed an acutely ill woman, holding the left side of her head and complaining of severe pain. There was a profuse, foul purulent discharge from the left ear from a perforation in Shrapnell's membrane, the drum was thickened, and no landmarks were present. Hearing was markedly diminished, and there was marked tenderness over the mastoid and emissary. Over an area of 3 inches (7.6 cm.) in diameter, completely surrounding and including the left auricle, the skin was red, tender, swollen and sharply demarcated.

The provisional diagnosis made was erysipelas, acute exacerbation of chronic middle ear suppuration with intracranial involvement.

The blood count revealed: white blood cells, 19,400; polymorphonuclear cells, 92; lymphocytes, 8. Under markedly increased pressure, lumbar puncture yielded 25 c.c. of clear spinal fluid containing 20 lymphocytes. Smears and cultures were negative. Blood cultures also were negative.

On December 11, erysipelas was spreading, and it was deemed inadvisable to operate through an erysipelatous area but to wait for a subsidence of the erysipelas. On December 14, the discharge from the left ear was decidedly less. On December 16, blood culture yielded a hemolytic streptococcus. The patient became irrational, still complaining of headache, and for the first time there was rigidity of the neck. Clear spinal fluid, under markedly increased pressure, was removed and contained 1,200 cells, 92 of which were polymorphonuclear form. The ocular fundi gave negative findings throughout. On December 17, under markedly increased pressure, cloudy spinal fluid was removed, and contained 1,330 cells, of which 90 were of polymorphonuclear type. On December 18, the erysipelas was fading, but headache persisted, though rigidity of the neck was much less marked. On December 21, under slightly increased pressure, a clear spinal fluid was removed and contained 320 cells, of which 80 were lymphocytes. Simple mastoidectomy was performed and the mastoid was found to be sclerosed. The bone on the outer antral wall and floor of the antrum was softened by disease. There was a large perisinous abscess, and an escape of pus from between the sinus plate and the sinus in the angle between the middle and posterior fossas. The dura over the floor of the middle fossa was normal. On December 26, cloudy spinal fluid, under markedly increased pressure, was removed and contained 3,700

cells, of which 77 were polymorphonuclear. At operation, the lateral sinus from the bulb to the torcular was found to be filled with a purulent thrombus. The inner sinus wall was thick and closely adherent to the cerebellar dura. On December 27, spinal fluid, under markedly increased pressure, was removed, which contained 1,700 cells, 40 of which were polymorphonuclear and 60 were lymphocytic. The patient became very dull and apathetic, and had marked spasticity of all extremities. She then lapsed into coma. The spinal fluid of this day was found to contain hemolytic streptococcus, but was not reported until after an exploration of the left cerebellum, December 28, which was negative. On December 29, the patient died.

Necropsy.—The postmortem examination showed the dura in the operative wound somewhat adherent. The pia-arachnoid was injected and showed a small amount of purulent exudate along each side of the superior longitudinal sinus. A similar exudate was found over both temporal lobes and the base of the brain. The left cerebellar lobe contained an abscess, 5 by 5 cm., filled with yellowish pus. The abscess was located in the dorsolateral position. A recent thrombus was found in the lateral sinus from bulb to torcular. The jugular bulbs were not involved. Section of the lateral sinus showed a septic thrombus containing gram-positive cocci.

THROMBOSIS OF THE SIGMOID SINUS FOLLOWING SKULL FRACTURE

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REPORT OF CASE

On Dec. 6, 1924, a man, aged 27, was brought unconscious to St. Luke's Hospital, and admitted on the service of Dr. E. Lee Miller. The patient had been thrown from a car to the pavement. A roentgen-ray examination showed a stellate fracture of the posterior parietal and occipital bones of the left side of his head. He had a temperature of 97.2 F., a pulse rate of 82, and 27 respirations to the minute. The blood pressure was 120 systolic, and 70 diastolic.

Within a few hours the patient regained consciousness and appeared to be improving. His temperature remained normal until the fifth day following the injury, when it rose to 101 F. He complained of severe pain in his left ear and left anterior side of his neck over the course of the internal jugular vein. There was no bleeding from the ears or nose at the time of the injury, and the patient had never had any ear trouble.

At this time I was called to see him. He answered questions promptly, but was inclined to cry, and said that his left ear hurt. He was very sensitive about the ear, which showed a bulging black drum. On incision, a considerable quantity of old, black, semi-broken-down, bloody fluid exuded, which was under pressure.

The following day he had a severe chill with a sudden rise in temperature to 104.2 F. The leukocyte count was 19,300 and the patient complained bitterly of pain over the left sternocleidomastoid muscle. The surface was quite tender over this area, but careful palpation did not elicit any cordlike feel of the internal jugular vein.

Twenty-four hours later the patient had another chill, at which time his respirations became very shallow, and he was quite cyanotic. He was almost pulseless and looked as if he were dying.

To open the sigmoid sinus so soon after a skull fracture was recognized as a hazardous procedure, but, in the face of a septic thrombus, it was all that offered the patient a reasonable chance of recovery.

Under a general anesthetic the mastoid cells were removed over the entire course of the sigmoid. There was no infectious destruction of these cells and the bone worked with difficulty. Near the upper end of the sigmoid, just posterior to the antrum, there was much old blood which had apparently exuded from a tear in the sinus wall, due to an extension of the fracture through the temporal bone.

Apparently the infection had extended from the old blood in the middle ear, back through the mastoid cells to the torn sinus. The sinus stood out like a rope and was completely thrombosed. The wall was smooth and presented no visible tear. When incised, it was found to be filled with a partially broken-down clot which extended from the torcular end above, to the jugular bulb below. This was removed, and the sinus wall was clipped off with scissors. There was no bleeding from the bulbar end. Cultures from the thrombus showed streptococci.

A gauze plug was inserted in the upper end to control the bleeding, and a gauze wick into the lower end of the sinus to serve as a drain. The internal jugular vein was not disturbed, as the phlebitis had already extended beyond the point of resection.

While the operation had consumed only twenty-five minutes, the shock to the patient was severe. Within an hour he became cyanotic and pulseless, and

Cheyne-Stokes respiration developed. It appeared that the trauma of pounding on the hard mastoid bone with the gouge and mallet had been too much for his already lacerated brain.

This condition of shock lasted for eighteen hours, when suddenly the patient began to rally, and twenty-four hours following the operation he was clear mentally for the first time since his injury. He remembered nothing after being thrown from his car.

He had two slight postoperative chills and developed several metastatic abscesses which required drainage. Although the blood culture was negative, a general septicemia was present.

The most painful and disturbing part of the convalescence was an acute arthritis of the knees, which cleared up in the course of a few weeks on weight extension. The man is now entirely well, and has a dry, normal functioning ear.

COMMENT

A thrombosis of the sigmoid sinus following a skull fracture without previous ear infection is unusual.

Rupture of the ear drums with bleeding is quite common, especially in fractures of the base.

It is quite probable that should this have happened, drainage would have been established, and extension of infection to the sigmoid would not have taken place.

Frequency of tears of the sigmoid without thrombus formation and infection is of speculative interest. The extreme shock following the mastoidectomy illustrates the amount of trauma which is produced by the gouge and mallet.

This case has suggested to me an air cushion pad which I have in the process of manufacture, and which I contemplate using in all mastoid work.

This case also seems to demonstrate that ligation of the internal jugular vein in sigmoid sinus thrombosis is not always necessary.

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Clinical Note

SPONTANEOUS EXPULSION OF A PEANUT KERNEL ONE YEAR AFTER ASPIRATION*

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The aspiration of a peanut kernel usually causes a severe reaction of the tracheal and bronchial mucous membrane, with edema and purulent exudate within twenty-four hours, and the patient becomes acutely ill. Death may soon follow unless the kernel is removed by bronchoscopy. Several observers, particularly Jackson, have called attention to this reaction and have attributed it to an intrinsic chemical irritant.

The following case is not reported in justification of awaiting the spontaneous expulsion of a foreign body, but to show that it is possible for a peanut kernel to remain in the bronchus for a long time without producing disability.

History.—A boy, aged 2, was examined on Dec. 17, 1924. In August, while eating peanuts, he fell and apparently aspirated a portion of a nut. He was dyspneic for half an hour, and there was a peculiar gurgling sound on respiration. For two weeks before examination he coughed considerably during the night, then the cough ceased although the peculiar respiratory gurgle persisted.

Physical examination of the chest revealed ronchi over both lungs, with diminution in the breath sounds over the right side. Roentgenograms were negative. A diagnosis was made of a foreign body, probably a peanut kernel or a part of a peanut shell in the right bronchus, and bronchoscopy was advised. The child's parents declined to have this examination because he seemed so well, so they returned home. A recent letter from his physician stated that a portion of a peanut kernel had been coughed out in August, 1925, one year after aspiration, and that the child is now perfectly well.

*From the Section on Medicine, Mayo Clinic.

PROGRESS IN OTOLARYNGOLOGY

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

FUNCTIONAL EXAMINATION OF HEARING

Review of the Literature from November, 1924 to November, 1925

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Owing to the fact that this review is scheduled to appear each year, in January, only those articles which come to hand from the first of November of one year to the end of October of the next can be considered. A general survey of the work for the last year shows that, to a very large degree, attention has been directed mainly to a few movements, so to speak, along the line of functional testing of hearing. One of the most prominent subjects is that of audiometers. Apparently these apparatus are not as yet well known, if at all, in Europe; at least the German literature, so far as I have been able to find, makes no mention of them. In this country, however, considerable attention lately has been paid to them. While in previous years, Dean and Bunch have published a number of excellent articles on work done with the Iowa pitch range audiometer, the literature of the past year reveals a number of articles in which the types of audiometer used by Knudsen and Jones, and one devised by the Western Electric Company, have also been employed.

Another topic in which great interest has been shown and, I believe, rightly so, has been the subject of bone conduction, in the attempt to find objective tests of head resonance in contrast to, or in connection with bone conduction as such. The opinion has been expressed in certain quarters that some of the work on functional tests has been in error, and that modification may be advisable. I believe that the subject of bone conduction is a most important one, in that the changes in this form of conduction have a very definite bearing on the matter of diagnosis and prognosis in the various ear conditions.

DIAGNOSTIC SIGNIFICANCE OF AUDIOMETER CURVES

Bunch [1] presents a number of graphs made with the pitch range audiometer in the various forms of deafness, and concludes that audiome-

1. Bunch, C. C.: The Diagnostic Significance of Audiometer Curves, Arch. Otolaryngol. **1**:147 (Feb.) 1925.

ter curves show accurately the relative hearing power over a wide range of tones. Tonal islands or gaps, together with regions of slight or marked loss of sensitivity, are apparent at a glance, and easily interpreted in the light of classical definition. On this basis, the audiometer distinctly aids in the differentiation of middle and inner ear lesions. So far as otologic procedure is dependent on the measurement of hearing, the audiometer is a distinct aid in actual practice, as this author see it.

PROBLEM OF THE TESTING AUDITION

Kranz [2] discusses the testing of hearing with a new portable audiometer used at the Riverbank Laboratory. This instrument is constructed to give a continuous variation of pitch from 200 to 6,000 cycles per second.

> So far as the vacuum tube oscillator is concerned, if equipped with the proper inductances and capacities, it will function at 1 cycle per second as well as at 1,000,000 per second, the latter being the frequency used by a radio station broadcasting on a 300 meter wave; the electric oscillations for the broadcasting station being generated in an exactly similar manner to this oscillator, and being governed or tuned by the values of inductance and capacity used. So we have all of the control over the frequency which we wish.

It is this type of vacuum tube that is being used, not only by Kranz, but by a number of others in various audiometers, such as those of Guttman, Knudsen and Jones, and of the Western Electric Company. The intensity of sound in this machine is easily regulated by means of a switch. Instead of a telephone receiver, the author uses a thermophone whereby it is possible to calculate the pressure of sound waves on the ear-drum.

A number of cases are reported, with comments thereon. The author feels that the best way of indicating acuity of hearing in the person tested is by a curve. He suggests also that it might be useful to express the degree of hearing in a single number. Kranz feels that this is best obtained at the present time by the use of the conversational voice, delivered to the patient in some manner whereby the intensity can be regulated and read.

The author states that, from the practical standpoint, the speech range is considered by telephone engineers to be about 200 to 2,000 double vibrations per second. In other words, this means that a person could be totally deaf to all frequencies above 2,000 cycles per second, and yet get along very well in conversation, which is what people are actually most interested in as regards their hearing. An apparent disagreement with this conclusion is indicated by tests made with isolated

2. Kranz, F. W.: Some Aspects of the Problem of the Testing of Audition, with Demonstration of a New Portable Apparatus, Arch. Otolaryngol. **1**:79 (Jan.) 1925.

syllables, which have shown that with all frequencies above 3,000 double vibrations eliminated, there are still some syllables which are not understood correctly, but these tests do not take into consideration the very important factor of the context occurring in actual continuous speech.

TESTS BY AUDIOMETER NUMBER 2-A

Drury [3] examined various groups of persons regarded as having average normal ears, that is, without known or demonstrable impairment of aural acuity. The instrument employed was the audiometer Number 2-A (Western Electric Company). Of the 500 subjects examined, there were 245 males and 255 females. The average ages were 18.4 and 18.5 years respectively. Ten groups of fifty subjects each were selected with wide diversity in social and physical condition.

Summary of the results obtained was as follows:

1. So called normal persons differ significantly in their keenness of hearing, and tests frequently show disparity in the sensibility of the two ears.

2. High notes are apparently more readily perceived than low ones.

3. The upper limit of audition varies considerably for different normal persons.

4. The influence of health and training is illustrated by the curve of the average experienced telephone operator.

NEW METHODS FOR TESTING ACUITY OF HEARING

In a paper replete with mathematical formulas, Fletcher [4] strives to standardize hearing tests made with audiometers and speech (as used in the "average whisper, low whisper, mezzo forte voice and fortissimo voice"), tuning forks, watch tick and acoumeter, etc.

The author studies the relation of these various methods of testing hearing, and attempts to reduce them all to terms of sensation units. The scale for measuring the hearing is the one indicated on all audiometers made by the Western Electric Company, and Fletcher states that if the results of the various hearing tests are reduced to loss in sensation units, then the findings of one observer will be comparable with those of another.

In line with this, he shows that if the damping "constant" of a fork (that is, the rate of decrement of the fork's vibrations) is known (this can be determined by the manufacturer, and a certificate thereof accompany each new fork), every otologist can calculate the patient's impairment of hearing in terms of loss of sensation units.

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3. Drury, Dana W. Tests of Five Hundred Average Ears by the Audiometer No. 2-A, Arch. Otolaryngol. **1**:524 (May) 1925.

4. Fletcher, Harvey: Laryngoscope **35**:501 (July) 1925.

At the time of giving the fork a standard blow, start the stop watch. Hold the fork to the patient's ear in the standard way, and stop the watch when the patient signals he no longer hears. Subtract the time in seconds given by the stop watch from the normal hearing time, and then multiply by the "constant" of the fork to obtain the hearing loss in sensation units.

This author also states that this test may be done by comparing the actual time that the patient hears the fork with the hearing of the examiner, but I believe that the method in which the hearing is compared with that of the average duration that the fork is heard by a normal person is much the better and more objective manner; it is the one that I have recommended doing when making the usual tests for bone conduction by means of the Schwabach test. In order to obtain a standard for any one fork, it should be struck in a uniform manner and applied to the bone with equal pressure, and then with a long series of apparently normal cases the average at certain ages determined for that fork. With this definite standard in mind, it is then very easy to compare the hearing of this fork by patients without reference to any living control.

I believe that the method suggested by Fletcher is an excellent one. By using the "constant" of the fork as before described, accurate results should be obtained, and the findings should be comparable with those of other observers in the same manner as are the graphs of the audiometers.

VALUE OF HEARING TESTS BY THE AUDIOMETER

Dowling and Wegel [5] describe the audiometer briefly, and then present observations on a large series of cases, checking their findings by functional and other tests when indicated. In contrast with the large element of error when testing with tuning forks, due to different methods of activating the fork and differences in the make of forks, the audiometer gives a purer tone of standard intensity, and the minimum that is said to be necessary to excite the auditory nerve, rather than the length of time during which the tone is heard; that, in substance, is the view of the authors.

If the audiometers are standard, and audiograms made by one observer on these instruments show the same curve as those taken on a different instrument by another observer, these results may be compared one with the other. Dowling presents audiograms and reviews the findings in a number of cases of deafness of different varieties; there is a description by Wegel, together with a photograph of the type of audiometer used.

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5. Dowling, J. I., and Wegel, R. L.: Laryngoscope **35**:525 (July) 1925.

It seems to me that there must be a little confusion either in the minds of one of the authors, or else some error in the use of the expression which occurs in the following paragraph:

> In cases of impaired hearing due to obstruction of the external auditory canal, the sharp curve will show the greatest drop in the low tones in cases of simple type. The fineness of the audiometer record is such that it suggests in some cases of this nature an irritable auditory nerve (probably an initial congestion incident to a possible eustachian tube factor). In such cases a sharp curve for high tones may also show quite a drop and disappear promptly after the removal of the offending obstruction to the canal, for the complicating eustachian tube factor will recover spontaneously on the removal of the obstructing pathology in the external auditory canal.

It is not quite clear how an obstruction in the external auditory meatus due, for instance, to a plug of cerumen, will ordinarily give signs and symptoms of an inner ear lesion with loss of hearing for the high tones. Surely the auditory nerve must be irritable if it is at all normal, and why it should be hypersensitive in the case of obstruction to the external auditory canal, I do not see. I have found in many cases of acute otitis media that there is a marked hearing impairment of the high tones, due possibly to some involvement of the inner ear by way of the round window. As a rule, when the otitis media subsides, the hearing for the high tones returns. When the middle ear is thus involved, it is possible to have a direct extension to the inner ear, but when there is only a mechanical obstruction in the external auditory canal, it is difficult to explain the apparent findings of an inner ear involvement, and I do not understand how the audiometer in these cases of mere occlusion to the meatus gives findings pointing to auditory nerve involvement.

It is possible that the signs of inner ear involvement might be caused by a firm plug of cerumen which is pressing very firmly against the drum membrane, with pressure on the ossicles and the footplate of the stapes, as in a positive Gellé test. After removal of the cerumen, of course, all signs of inner ear involvement should be gone. However, the presence of obstruction in the external auditory canal could not very well produce eustachian tube involvement so far as I can see; as a rule, this is most likely to arise by way of the pharynx or nasopharynx.

POTENTIALITIES OF THE AUDIOMETER

Goldstein [6] reviews briefly the history of the audiometer, and mentions the various types that have been used in the past, beginning with Seashore's apparatus in 1897, up to the present time. At the close of the thirtieth annual meeting of the American Laryngological, Rhinological and Otological Society in St. Louis in May, 1924, most of the

6. Goldstein, M. A.: Laryngoscope **35**:538 (July) 1925.

newer models were given a practical demonstration at the St. Louis Institute for the Deaf, and the author has summarized the discussion which took place at that time. In brief, the conclusions are:

1. The total range of the audiometer should include the full maximum limits of normal audition, that is, from about 16 to 24,000 double vibrations.

2. Tone intensity as developed in the audiometer is expressed in dynes, and while the intensity of 120 dynes is ample for the range of serviceable hearing, an increase in sound intensity up to 200 dynes is urged.

3. A special bone conduction receiver should be added to the regular equipment of audiometers.

4. Audiometers should be uniform in standard of calibration and in the recording of functional tests, and a uniform method of noting results is urged.

5. The adoption of the musical scale, with seven definite intervals to the octave, is recommended for use in the research models of the audiometer.

6. Furthermore, the audiometer would be useful in determining progress in hearing, and to note the deterioration of this function by repeated graphs.

I believe the author's point is very well taken regarding the desired range of pitch of audiometers, namely, from 16 to about 24,000 double vibrations.

AUDION BULB CIRCUITS

Jones and Knudsen [7] discuss the principle of the audiometer, and emphasize its adaptability as follows:

Amplification by the audion bulb circuit, using conversation voice, whisper or for that matter, any tone or sound, is capable of overcoming any interference in the conduction apparatus of hearing. This allows one to test the cochlea directly. If the "deaf" ear can hear the faintest whisper, or if amplification enables the so-called "deaf" ear to hear perfectly, a lesion of the conduction apparatus only is present. If cochlear lesions are suggested, the patients state that the "words all run together or sound confused."

Amplification may be applied to any desired range of frequency, and it is hoped that using the principle of the audion bulb aids to hearing not possessing the defects of those already at hand may be developed. Such new aids should selectively amplify those frequencies which the patient hears poorly.

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7. Jones, I. H., and Knudsen, V. O.: Audion Bulb Circuits in Otologic Practice, Arch. Otolaryngol. **2**:335 (Oct.) 1925.

To quote the authors:

> The main contribution of the audion bulb to otology is that it makes possible a more precise and yet a rapid determination of the type and degree of a hearing defect. By reducing the loudness of speech or tones to the minimal threshold of audibility, one is able to make a quantitative estimate of function. Again, because of the fine gradations of tone which the audion bulb makes available, one is, in some instances, able to determine the exact pitch and loudness of the tinnitus. By the same facilities for precise measurements, one is enabled, not only to demonstrate the presence of diplacusis, but also to determine whether one or both ears hear "off pitch." One is also enabled to determine the pitch separation in the two ears.

The question of audiometers is a very large one, and one which cannot be very definitely answered one way or the other at the present moment. The great advantage of the audiometer seems to lie in the fact that one is able to obtain an audiogram or graph which can easily be compared with future curves and a change, if any, of audition noted, or the graphs of one otologist may be compared with those of another. In testing malingering, it is also possible to accomplish a good deal, since records may be kept of the percentage of hearing of the various pitches that the patient admits hearing on one day, and compared with findings on other days, the subject not being able, of course, to remember the intensity heard on previous times. However, by means of a simple tuning fork test such as the Stenger test, it is also possible in the most definite manner to detect malingering or simulation of unilateral total deafness. Audiometers also will be of great service, no doubt, for examining and rating large groups of persons either for industrial or for educational purposes, especially with that form of apparatus which has many ear pieces, so that a considerable number may be tested at the same time.

On the other hand, even with the best methods of calibration, unless the percentage loss of hearing or sensation units is made to read the same on all types of audiometers, it will be impossible to compare properly the graphs obtained by one man with one apparatus with those made by others with different audiometers. I hope, therefore, that a definite standardization of the methods of recording results with the various audiometers will be adopted.

The hearing for the human voice (unaccentuated whisper or unaccentuated conversation), is the most important criterion of aural efficiency, even though it cannot be well standardized. But from a practical standpoint, sufficient data may be obtained with whisper or conversation without any apparatus if simple principles regarding the closing of the eyes, the occlusion of the opposite ear, the use of a proper room, etc., are observed. So far as I am aware, the voice test cannot be made with audiometers except with a phonograph attachment; even this, it seems to me, is not the same as the use of the human voice.

Only one of the audiometers (that made by the Western Electric Company), is being commercially produced. One of the biggest objections that I can see to this apparatus is its great expense. The Type 2-A for office work costs almost $600, and the large research type almost $2,000. It has been found extremely difficult to induce the average otologist to spend even $50 or $75 for five or six tuning forks with which to do tests; how much more difficult it will be to get him to invest in so expensive an apparatus. It seems to me that it would be better for those otologists throughout the country who desire only a modest instrumentarium to do the fundamental tests, such as the Weber, Schwabach and Rinne, with a few good standardized forks, test the whisper and conversation voice, and determine the high tone limit, with one of the better type whistles or with the monochord. To this equipment an audiometer may also be added if desired. The office type of audiometer before mentioned only has a range of from 64 to 8,192 double vibrations, with tones one octave apart. With the tuning forks it is possible to test sounds as low as 16 double vibrations; with the Edelmann-Galton whistle and the monochord, tones up to 20,000 double vibrations or higher may be obtained. With the very expensive research type of audiometer it is also possible to get sounds from 16 to 22,000, or higher, and recently announcement has been made of the fact that an attachment for testing bone conduction has been added.

Calibration of audiometers is usually arranged so that the percentage of hearing loss can easily be read. As has been stated previously, if the damping "constant" is known, it is possible by means of the tuning forks to determine the percentage of loss of hearing in sensation units just as easily as with an audiometer.

It is my belief that audiometers should be given a good trial; and used as aids to, and in conjunction with, the voice, tuning forks, whistles and monochord in functional tests; then we may be able to arrive at a definite conclusion as to which method or methods are the more practical, economical, and satisfactory in making a diagnosis of the character of hearing impairment which is present.

MEANS AND METHODS OF TESTING IN AURAL DISEASE

In this paper, which served as a lecture delivered in University College Hospital Medical School, Richard Lake [8] discusses the various tests of the function of hearing. First, he dwells on the qualities of sound, especially the influence of the overtones in this connection. Speaking of the use of the human voice, he suggests the employment of phonograph records to give a fixed intensity of sound and thus

8. Lake, Richard: Means and Methods of Testing in Aural Diseases, Arch. Otolaryngol. **2**:340 (Oct.) 1925.

obviate the differences in the individual examiners. The author finds that most of the noise apparatus used in the testing of unilateral deafness have certain disadvantages, in that the sound is conducted to the healthy ear. He further states that, in middle ear disease, the noise apparatus increases the patient's ability to hear, whereas this is quite the reverse in cases of nerve deafness. He does not, however, describe just how it happens that the use of a noise apparatus increases the audition in cases of middle ear disease.

Tuning forks are discussed, stress being laid on their proper handling, their deficiencies, etc. The author is distressed by the fact that tuning forks, as a rule, have certain overtones. It was shown long ago that either by the use of weights, or by the placing of a thick rubber band on the distal third of the prongs, or by very carefully fashioning the fork, overtones are to a great degree, if not entirely, eliminated. Lake calls attention to the importance of uniformity in excitation of the fork, a point in which I am most heartily in agreement with him. I cannot, however, coincide with his view of the entire worthlessness of the Weber and the Gellé tests. He states that he uses the Rinne test, but considers the Bing test "as the most valuable tuning fork test which we possess, for if in a case of deafness, the bone conduction is longer than that through the column of air, it is then a positive indication of nerve deafness and it appears to me that this is correct in all cases." He does not "consider that the Galton-Edelmann whistle is of great clinical utility, though of great value from a purely scientific point of view"; he prefers the monochord, and states "that with a little care and the relative proportion of air and bone conduction taken, one has the most reliable indication of the condition of the auditory nerve, far more reliable indeed than that given by any tuning fork test except that of Bing." Lake admits that the actual details of the Bing test are variously defined. I would like to state in this connection that in the Vienna Clinic this test was not considered of great practical value. Many years ago Alexander taught that the Bing test was used for determining the influence that the closure of the auditory meati exerted on the duration of bone conduction. To use his words communicated to me many years ago: "In the Schwabach test, if the meati are closed with the fingers, we normally get lengthened bone conduction; but middle ear disease, the bone conduction is already considerably lengthened so there is no increase by this method; when there is inner ear disease closing the meatus or meati, can lengthen the bone conduction somewhat."

There is another variety of Bing test which, while it has no direct bearing on the subject in hand, may be of interest to otologists. In this form, which is also called "entotic test," a speaking tube is connected

with a catheter introduced into the eustachian tube, so that the sound waves enter the tympanum directly. If speech is heard better this way than when the tube is inserted into the external auditory meatus, it means that the interference with sound conduction is not in the stapes, but lies in the tympanic membrane, malleus or incus.

THE WEBSTER PHONOMETER

Because of the diversity of opinion in various quarters, with reference to which portion of the tuning fork should be presented to the ear, I [9] undertook an investigation to determine accurately which portion of the prongs of the fork (the broad or outer surface, the narrow surfaces held lengthwise, the very ends of the prongs, or the angle between the broad or outer and narrow surfaces of the prongs), emits the greatest intensity of sound.

Following a discussion of the physics of tuning forks, a description of the instrument known as the phonometer devised by the late Prof. A. G. Webster of Clark University is given. It was with this appliance that the intensity of the sound was studied. The phonometer responds only to that pitch to which it is attuned, and has a range of from 200 to 400 double vibrations. I used the pitch of c-1 (256 double vibrations) for this purpose, having two very accurate forks of this pitch, one electrically driven, the other excited by a pendulum. Besides the phonometer and forks, resonators and the human ear were also used in the various tests.

So far as possible, the forks were placed as near the phonometer as the usual distance at which the prongs are held from the ear in the ordinary hearing test. Following numerous experiments with these two types of forks, the resonators and the ears in conjunction with the phonometer, I arrived at the following conclusions:

1. Even with an electrically driven fork, it is quite difficult at times to get uniform intensity of sound due to the variation in the spark, etc. Excitation of the fork by means of a pendulum weight seems to give fairly uniform and reliable stimulation.

2. It is from the broad or outer surface of the fork that the greatest intensity seems to arise.

3. The narrow surfaces of the prongs held lengthwise usually give an intensity next in degree to that of the broad or outer surface; and one that is greater than the very ends of the prongs.

4. The ends of the prongs give a greater intensity of sound than do the angles between the broad and narrow surfaces. It is at the latter

9. Sonnenschein, R.: A Study with the Webster Phonometer of the Sounds Emitted by Different Parts of the Tuning Fork Prongs, Arch. Otolaryngol. **1**: 170 (Feb.) 1925.

place that there is interference between the condensation and rarefaction of the sound waves; hence very little tone is emitted at this point.

5. For clinical purposes, it therefore seems best to present the outer or broad surface of the prongs parallel to, and as close to the ear as possible, without touching the auricle or vibrissae. If the narrow surfaces are held in the same manner, only a moderate difference in intensity will be noted. The main point is that there should be uniformity in the manner in which forks are held near the ear, in order to get uniform results in the testing of acuity of hearing.

BONE CONDUCTION

Downey [10] discusses Runge's studies of bone conduction, with special regard to his "water filling" test. This is carried out by first taking the bone conduction with the fork on the mastoid; then the head is bent to one side, 1 c.c. of water is instilled into the external canal of the uppermost ear, and the bone conduction is again tested.

In the normal ear, Runge found that water filling about doubled the duration of perception by bone conduction with forks up to c-2 (512 double vibrations), but that above this pitch the reaction is not so pronounced. In pathologic cases the results are entirely different.

1. After the radical operation, water filling does not increase the bone conduction.

2. If there was evidence of complete fixation of the stapes, the test does not increase the bone conduction.

3. If there was only partial ankylosis somewhere in the ossicular chain, the water filling gave only a moderate increase in the duration of bone conduction.

4. If there was evidence of cochlear degeneration, bone conduction which was greatly reduced could usually be somewhat increased by the water filling test.

5. In the early and in the final stages of acute otitis media, the bone conduction is usually diminished somewhat as compared with the normal ear; in well-developed acute otitis media, the bone conduction is not increased by the water filling.

Downey examined more than fifty patients, using the test in cases of chronic progressive deafness of various middle ear types, acute and chronic purulent otitis media, after the radical mastoid operation, and in cases of perception deafness. He used routinely a c-2 fork (512 double vibrations) that in his experience was normally heard for not

10. Downey, J. W., Jr.: A Clinical Study of Bone Conduction After the Method of Runge, Arch. Otolaryngol. **2**:260 (Sept.) 1925.

less than 20 nor for more than 30 seconds. In the main, Downey confirms Runge's findings, declaring he has found this test of definite value in the diagnosis of complete or partial stapedial fixation, and in differentiating between conduction and perception deafness.

I reviewed Runge's original, long and detailed article in the summary of literature on functional examination of hearing in the January, 1925, number of the *Archives of Otolaryngology*. I believe that the principles involved in the Runge test are similar to those of Bing's when the finger is placed in the external auditory meatus. Just as in the Bing test, we then find that if bone conduction previous to the test was already increased, there will be no further lengthening of it by means of the obturation of the meatus. In those patients in whom bone conduction has been relatively diminished through a perception apparatus involvement, closing the external auditory meatus whether it be with water, the finger or any other obturator, will usually increase bone conduction somewhat. While this method with the water filling offers a very happy way of testing this possible increase of bone conduction with different lesions, it also opens a path for further investigation regarding the effect of the quantity of fluid, weight thereof, and pressure which may be exerted against the drum membrane and ossicular chain.

HEAD RESONANCE TESTS

Schoen and Goldberger [11] call attention to the fact that most of the tuning fork tests depend to a large extent on the subjective statements of the patients, and that it would be very desirable to have some objective measure. They then describe their procedures, testing the head resonance by means of a double phonendoscope which connects the examiner's ears with the patient's external auditory canals or with his skull.

They divide the testing of bone conduction into three separate parts; first, in which the function of the skull as a resonator, second, in which the perceptive ability of the organ of hearing, and third, in which the actual conduction of sound through bone, is considered.

The method of examination consists, in the main, of two parts.

1. The tuning fork is placed on the head of the patient in the median line of the vertex, on the forehead, on the root of the nose, on the external occipital protuberance, or in the region of one of the nasal accessory sinuses (the frontal, ethmoidal or maxillary).

2. For control of the perception acuity of the patient, the tuning fork is placed on the head of the examiner. The patient's ears (as

11. Schoen, S., and Goldberger, K. Monatschr. f. Ohrenh. **59**:19 (Jan.) 1925.

before stated) are connected with those of the examiner, and he is made to give answers with reference to the conduction of the sound.

The authors believe that by this method they demonstrate that the skull acts as a resonating chamber which responds especially to the deeper tones. Furthermore, by means of the phonendoscope, this resonance can be tested objectively. They are also of the opinion that by this method they are able to make the diagnosis in various ear conditions without the aid of the ordinary tests such as the Weber, Schwabach and Rinne.

It seems to me that many of the points brought out by the authors are very interesting, but some of them are not wholly new. By a simple experiment, Bezold long ago showed that air conduction is usually longer than bone conduction in that when a tuning fork is placed on the head of individual "A", and he no longer hears the sound, individual "B", whose ear is connected by monaural stethoscope with "A" 's head, can still hear the tuning fork for about ten seconds longer. Schoen and Goldberger have come to the same conclusion; they say it is a very important and interesting phenomenon, that the tuning fork vibrating on the head of the patient is heard as long or even longer by the examiner, who, of course, is hearing by air conduction. Bezold also emphasized long ago that the craniotympanic route of conduction is better by far than the direct craniolabyrinthine route.

TUNING FORK TESTS OF THE SYNERGISTIC ACTION OF BOTH EARS

Having postulated synergism in the reaction of one ear on the other, Kreidl and Gatscher [12] describe two methods by which this fact apparently is demonstrated.

1. A low pitched tuning fork, previously struck, is held very close to one ear, which is tightly closed in order that one may be sure that the sound is not being conducted to the opposite ear. When the tuning fork is sounding in the first ear (which, of course, now is not occluded), a vibrating fork of the same pitch is brought closer to the opposite ear, until at a certain definite distance an increase in intensity of sound is heard in the first ear. To demonstrate that the second ear does not appreciate any sound (as in the Stenger test), the tuning fork is brought nearer the second ear and finally a sound heard in that ear which is diotic, which leads to localization in the median line of the skull, and is decidedly stronger in summation than the two tones separately produced.

2. Instead of using air conduction, the tuning fork is placed on the skull and by means of closure of one ear, the sound is perceived only in

12. Kreidl, A., and Gatscher, S.: Monatschr. f. Ohrenh. **59**:41 (Jan.) 1925.

that ear (Weber test), then with a fork of the same pitch approached to the second ear, it is impossible, at whatever distance, to produce an increase of the sound in the first ear. Furthermore, in this test, gradually approaching the tuning fork from a long range with certain variations in the distance from the ear, one can notice the diotic phenomenon, so that in a short time this tone is noticed only in the second ear.

In the first case, stimulation of the central organ results in the monotic impulse and localization of the tone in the side of stimulation. If now a qualitatively similar, but quantitatively decidedly smaller stimulus is presented to the other ear, one must assume that also in this case there is stimulation of the central organ. It is better, therefore, to allow two stimuli different in source to endeavor to combine. It is known that with a dichotic transmission of two qualitatively and quantitatively dissimilar sound stimuli, perception of tone should be in the median line of the skull. This sound is greater than the sum of the two elements, a phenomenon which the authors regard as an expression of central synergism.

In the second test (Weber), the condition at the beginning of the test is essentially different. Placing the tuning fork on the head stimulates both ears, and the median line, therefore, will receive impression from both hearing organs. The closure of one ear so changes this status that it alters the localization because one ear is stimulated the more. It is not as yet known to what extent the increase of the tone is due to closure of the ear, but it can be shown that the tone produced by the placing of the fork on the vertex is transmitted to the ear, when a second tuning fork is approached close enough so that each tone itself is appreciated. The increase in sound, therefore, seems not to be a very great one, but the difference in the degree of the stimuli cannot be a very decided one; in any case it is smaller than in the first test.

The authors believe that these investigations will engage the interest of the otologist, and will help to solve problems relating to physiologic and pathologic phenomena that may be of value in a diagnostic way.

The authors have published several contributions along physiologic and acoustic lines, and it is to be hoped that in future communications they will tell of the further development of these interesting studies, their applications as far as possible to the diagnosis and prognosis of otologic conditions.

THE PROBLEMS OF AIDS TO HEARING

In this communication, Frey,[13] in speaking of the various apparatus and aids to hearing, considers a number of the more common instru-

13. Frey, Hugo: Monatschr. f. Ohrenh. **59**:45 (Jan.) 1925.

ments. The various appliances suggested for use from time to time consist more or less of three distinct types, as exemplified by the simple and well known hearing tube, the parabolic ear trumpet, and the microphone with its various modifications. The designers of the different aids all sought methods for reinforcing feeble sound sources. With the speaking tube, this is done by means of the concentration of sound in one direction, mainly toward the ear, without loss to the wall of the tubing.

According to Zwardemaaker, there is no increase in the intensity of the sound, but the hearing tube merely brings the source of the sound closer to the ear. The parabolic ear trumpet differs from the hearing tube in that the sound source is increased partly by resonance, and also partly by being brought to a focus near the ear. With the microphone, by means of the electrical current, there is an amplification of the original tone source.

Frey asks why it is, if the problem of amplification of sound is solved, so many of these apparatus do not give satisfactory results in practice. He says that it probably lies in the fact that it is not so much a question of the amplifying powers of the apparatus as it is their lack of sensitiveness. To put it graphically, the author states: "The hearing appliances are more hard of hearing than the people for whom they are intended."

It must be remembered that the intensity of sound varies inversely as the square of the distance, and therefore it is that with so many apparatus when the source of the sound is very close to the ear they aid the hearing considerably, but when the distance is somewhat increased, there is a very appreciable diminution in their efficiency. Furthermore, be it remembered that Zwardemaaker calls attention to the fact that a hearing distance of 2 meters for whispered single isolated words corresponds to a hearing distance of only 2 meters for conversation with flowing speech; therefore, there must be a relationship of the hearing for isolated words compared to that of continuous speech as eight to one. Again, in most examinations, the speaker is projecting his voice directly toward the ear and apparatus, whereas in an ordinary conversation this is not true. Furthermore, the listener usually displays rapt attention when the examination is being conducted. In order to make the apparatus of greater practical value, it will be necessary to so increase their sensitiveness that hearing for speech shall be increased to a distance of, let us say, 6 meters and more.

The author calls attention to the inefficiency of most hearing devices, of which fact I have been painfully aware. If anything can be done which will materially increase the sensitivity of the appliances without adding to their weight or expense, it would prove a great boon to those

who are hard of hearing. It probably will have to be decided by the electrical engineer; a move in this direction has been made by means of the vacuum tube oscillator, which has already been installed in some of the newer devices in this country, and which gives greater amplification of sound.

AN AID TO LIP READING

Muck [14] was led to the discovery of a little point in the teaching of lip reading to the deaf or hard of hearing, by two observations. In the first instance, his attention was called to the fact that a number of apparently deaf or hard of hearing persons had, in an incredibly short time, learned lip reading in regular classes which had been organized for teaching those whose hearing had been impaired in the war. On investigation, it was found that these soldiers still had some remains of hearing, and Muck concluded that they heard subconsciously while watching the teacher speak. They were, furthermore, able to memorize the formation of lips used, pronouncing the different words and thus learned the method very quickly.

The second observation was made on a patient who had been wearing a tracheotomy tube for some time. She was not able to speak or even whisper. However, she tried to repeat the words which she heard, and the author was able to see, even though she enunciated and produced no sound, that she placed her lips in the position corresponding to the words she was trying to say.

From these facts he conceived the idea that, instead of having pupils endeavor to form words merely from instruction, a teacher might noiselessly say words or rather move his lips, the hard of hearing pupils can watch his lips and try to pronounce or whisper the words which the teacher's lips are forming. This method could surely be used in addition to the customary exercises, and especially could be employed when the pupils are fatigued. The author states that in one of the large institutions for the hard of hearing, this method was tried and was said to give most excellent results, in that the pupils learned much faster and without nearly the fatigue that was true of the methods formerly used.

THE EFFECT OF THE VASOMOTORS ON HEAD RESONANCE AND BONE CONDUCTION

Démétriades [15] made many experiments on animals and on three human beings, in whom the unilateral resection of the sympathetic nerve had been performed. As a result, he came to the following conclusions:

1. Dilatation of blood vessels due to paralysis of the vasomotors produces an increase of the head resonance on the side of the paralysis.

14. Muck, O.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **9**:545, 1924.
15. Démétriades, T. D.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **9**:296, 1924.

2. Stimulation of the vasoconstrictors causes diminution of the head resonance on the side of the stimulation.

3. As a result of the failure of reflex contraction of the blood vessels which causes vasomotor paralysis, the resonance is increased because of passive congestion of the deeper lying structures.

4. The middle ear and external auditory canal influence head resonance, but it is possible that too much significance is attached to hyperemia (due either to dilatation of the blood vessels or to active inflammation).

5. Auscultation by way of the skull, and by way of the external auditory canal, does not always give the same value.

6. So far as one can transfer conclusions derived from animal experimentation to man, it may be said that the relation of bone to air conduction (Rinne test) is partly dependent on head resonance.

7. The vasomotors and the condition of the blood vessels play important parts in the increase, as well as the diminution of head resonance and bone conduction.

8. By means of the change in the resonance, it is possible to understand certain cases of injury to the acoustic nerve with increased bone conduction and a negative or a positive Rinne reaction. This may also be done with some malignant tumors and with congenital syphilis.

This is a most interesting communication, further investigation of which will probably lead to other interesting and important findings with reference to head resonance and bone conduction. Especially of late, has attention repeatedly been called by various authorities to the fact that we must differentiate between "head resonance," due mainly to the resonance of the various cavities of the skull, depending on the natural frequency of these parts of the cranium, and of the phenomenon which we call "bone conduction." A resonator responds best to any source of sound which has the same natural frequency as its own natural frequency, whereas the bone itself, by forced vibration, to a certain extent responds to most tones, the degree of conduction depending on various factors such as the thickness of the bone, presence of air spaces, adhesions of the dura, age of the person, etc.

BONE CONDUCTION AND A DIFFERENTIAL TEST FOR STAPES FIXATION

Lewis [16] believes that it is possible to differentiate between the ordinary conduction apparatus obstruction and stapedial fixation by a simple tuning fork test. By a stapes fixation he does not mean otosclerosis alone, but any condition which interferes with the proper mobility of the stapedial footplate.

16. Lewis, E. R.: Laryngoscope **35**:109 (Feb.) 1925.

The vibrating tuning fork is held on the root of the zygoma, and is normally heard almost as long and as loud as over the mastoid antrum area. He states that it is normally heard longer on the tragus than on the zygoma or mastoid. The same relation exists when the external auditory canal and tympanic cavity are the site of a simple obstructive lesion. Cases of nerve deafness also show this same relation, that is, the fork is heard longer and louder on the tragus than over the zygoma or mastoid. This relation is reversed, however, in cases of known stapes fixation. Lewis uses a fork of between 96 and 256 double vibrations, or the audiometer with the bone conduction attachment. In making the Weber test, he uses four points on the skull, namely, the occiput, the vertex, the glabella and the symphysis of the jaw.

In performing the Weber and the Rinne tests, the author obturates routinely the external auditory canal during these tests. In this way he believes he obtains additional data concerning the presence or absence of obstruction of the tympanic apparatus. A questionable lateralization by closing the canal on the same side may be unaffected or may be markedly pronounced.

When Lewis closes the external auditory meatus, as before described, he is really carrying out the Bing test, mention of which was made in Richard Lake's article in this review. In the paper by Minton and Sonnenschein on the use of the tuning fork stem for both air and bone conduction, read before the Chicago Laryngological Society, May 1922, the words of Stefanini of Turin are quoted. This investigator found that when the tuning fork is placed on the tragus the conduction of sound into the ear is largely by air. I believe that there is every reason to assume, *a priori,* that the hearing by way of the tragus would be considerably longer than by way of the mastoid or zygoma; first of all, because air conduction normally is longer than bone conduction; and secondly, because by way of the tragus we have conduction not only by air but also somewhat by cartilage and bone because of the attachment of the tragus to the skull. In other words, it is simply another method of doing the Rinne test. Instead of having the conduction purely by air, which is usually done with the prong of the fork or by means of a tubing and stem as suggested by Minton and Sonnenschein, we have here the added factor of the air plus the bone and cartilage when the fork is placed on the tragus as originally shown by Stefanini.

I have often observed, and no doubt this has also been the experience of most other otologists, that in many cases of acute otitis media, in the first stages even, or at least after the condition has fully developed, there is a negative Rinne reaction, as the hearing by way of the mastoid is longer than by air or by the tragus. While Dr. Lewis uses a rather low pitched fork, I have always made the Rinne test with a fork some-

where between 256 and 500 double vibrations, preferably with the Bezold a-1 (435 double vibrations) fork. The lower the pitch of the fork used, the more likely is the Rinne reaction to be negative. The higher the pitch of the fork, the more it tends to be positive. If the thesis of the author is correct, then it would seem that we must have a stapes fixation in many cases of acute otitis media, since the hearing of the forks by way of the mastoid or zygoma is often longer than by way of the tragus. This fixation evidently must be temporary, since we usually get the positive Rinne reaction again after the disappearance of all middle ear symptoms. How can it be shown definitely that we really have a fixation of the stapes footplate in all cases in which conduction of sound by mastoid or zygoma is longer than by the tragus?

THE RINNE TEST, WITH SPECIAL REFERENCE TO THE TUNING FORK STEM FOR BOTH AIR AND BONE CONDUCTION

I [17] have stated that the Rinne test is the most valuable of the various tuning fork tests, in that it gives so much information regarding localization of the lesion of hearing by comparing air with bone conduction. Unless the Weber test is deemed advisable, the Rinne abolishes the Schwabach test by way of the vertex, as the bone conduction factor of the Rinne test serves the same purpose when made by way of the mastoid process. It should be remembered, however, as shown both by others and myself, that bone conduction by way of the mastoid usually is about 50 per cent. longer than by the vertex.

It is not always appreciated that air conduction is considerably greater or longer than bone conduction. Especially is this observed when both factors are measured separately, using, for instance, the a-1 fork (435 double vibrations). With this fork, the hearing for air conduction alone is usually from sixty to eighty seconds, at least for young persons. When the stem of the fork is held against the bone, there is considerable damping, and therefore a shortening of the time of vibration.

The author suggests that both bone and air conduction be determined with the stem of the fork, thus utilizing the same type of vibrations for both tests. There are theoretic as well as practical objections to the use of the stem for determining bone conduction, and the prongs of the fork for air conduction. The vibrations of the stem are longitudinal, of great intensity but very slight amplitude; whereas the vibrations that arise from the prongs of the fork are transverse, of slight intensity and great amplitude. Furthermore, testing air conduction by means of the prongs is subject to considerable variation due to the condensation and rarefaction phenomena, especially when the fork is rotated. In addition,

17. Sonnenschein, R.: Laryngoscope **34**:929 (Dec.) 1924.

there is the slippage of air molecules around the prongs of the vibrating fork, varying with their amplitude and velocity of motion, a condition which is not present when the stem of the fork is utilized.

Minton and I found that if the stem of the fork is inserted into a rubber tube, hearing is only by way of the column of air in the tube and not by way of its walls. The rubber tube should not be too wide (about 0.7 cm.); the thickness of the walls of the tubing that was used was 1.5 mm., and the length was 51 cm.

The fork should be excited in a uniform manner each time, and when no longer heard with the stem pressed against the mastoid, the stem is inserted into the rubber tubing, the other end of which is applied to the patient's ear by means of an olive shaped hard rubber tip having cylindric lumen and thick walls.

The author concludes:

1. Physical experiments show that with the fork stem inserted in the end of a rubber tube, the sound waves are transmitted to the ear by way of the air column in the lumen, and not along or through the walls of the tubing.

2. Clinical findings show that with the fork stem in the tube connected with the ear as previously described, the sound in many cases is heard somewhat longer than with the prongs held near the ear by way of air.

3. In most instances of middle ear diseases, especially those with a negative Rinne reaction, the hearing by way of the tube was somewhat less than with the prongs, whereas if the hearing had been by way of bone conduction, it should have been increased with the tip in the ear. In general, the ratio between air and bone conduction corresponds very well with that obtained in the ordinarily performed Rinne test.

4. It seems, therefore, feasible to determine not only bone conduction as is usually done, but also the air conduction factor of the Rinne test by means of the stem of the fork.

TIME RELATIONS OF TUNING FORK HEARING WITH THE FORK AT DIFFERENT LOCATIONS

MacFarlan [18] finds that (1) with the stem of the tuning fork (c-1, 256 double vibrations) in the external auditory meatus as compared with it over the mastoid antrum, the hearing is longer with the fork in the former position.

2. Bone conduction is longer with the fork on the mastoid than it is on the brow. It is also longer with the fork on the upper teeth as compared with the brow.

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18. MacFarlan, D.: Laryngoscope **35**:208 (March) 1925.

3. The fork is heard longer when the stem is in the external auditory meatus than when it is placed on the upper teeth. Holding the "butt" of the fork in the external auditory meatus until it is no longer heard produces a deadening of the hearing for air conduction when the fork is removed. This dulness is recovered from in ten or twenty seconds; hence the fork must not be shifted from one position to the other without striking it a fresh blow.

4. Bone conduction from the upper teeth is better than from the forehead or antrum. Taking the Weber test on the forehead, one can tell to what degree the deaf person lateralizes by shifting the fork from the median line to the right or to the left side.

Let me quote from my article "The Study of the Schwabach Test in One Hundred Cases," which was published [19] in March, 1922. I did not use the same fork as MacFarlan, namely c-1 (256 double vibrations), but did employ three forks in all patients, namely, the A unweighted, 108 double vibrations fork; the c-1 weighted (154 double vibrations); and the a-1 unweighted 435 double vibrations fork. We found in this series that on the forehead the A fork was heard an average of forty-seven seconds, the weighted c-1 fork forty-three seconds, and the a-1 an average of twenty-one seconds. On the vertex, the average hearing for the A fork was forty-eight seconds, for the c-1 weighted fork thirty-four seconds and for the a-1 fork, twenty-two seconds. The grand average of all forks heard by way of the vertex was 34.7 seconds, and by way of the forehead, 37.3 seconds. Taking the averages of the two mastoids together, we found for the A fork an average duration of seventy-six seconds; for the weighted c-1 fork an average of sixty-six seconds, and for the a-1 fork an average of forty-one seconds, or a grand average of all forks by way of the mastoid of sixty minutes and nine seconds. Roughly speaking, this means a ratio between the hearing by way of the mastoid, and that obtained by way of the vertex or the forehead as three to two.

SPONTANEOUS NYSTAGMUS, VESTIBULAR AND FUNCTIONAL HEARING TEST FINDINGS

Mackenzie [20] discusses the diagnosis of various lesions of the labyrinth and the eighth or auditory nerve. In the circumscribed irritative labyrinthitis, there is in addition to the other findings, those of the tuning forks which are the same as in cases of middle ear suppuration either acute or chronic, which accompanied the labyrinthine involvement (usually of the external semicircular canal). The findings are those of impaired hearing of the conduction apparatus type.

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19. Sonnenschein, R.: Ann. Otol., Rhinol. & Laryngol. **31**:137 (March) 1922.
20. Mackenzie, G. W.: Laryngoscope **35**:611 (Aug.) 1925.

In circumscribed destructive lesions, besides vestibular findings, the fork tests indicate also an obstructive lesion so long as the nonacoustic labyrinth alone is involved.

In these diffuse labyrinthine irritations due to middle ear suppuration, the functional hearing tests are no longer of purely obstructive type. The Rinne test, while negative, is not as marked as it ought to be in a purely obstructive lesion, nor is bone conduction as short as it should be in a purely perceptive lesion. As the diffuse labyrinthine congestion improves, functional tests indicate a lessening of the perceptive form of deafness, that is, relative shortening of bone conduction.

In diffuse labyrinthine destruction secondary to middle ear suppuration, deafness is total, as indicated by inability to hear the whispered or conversational voice by way of the 2 or 3 meter speaking tube in the affected ear, with a noise apparatus in the unaffected ear.

In the labyrinthitis which is seen late in hereditary syphilis, the functional tests indicate a lesion of the perception type on both sides. Destructive labyrinthitis due to necrosis and sequestration of perilabyrinthine osseous tissue gives the same tuning fork findings as diffuse suppurative labyrinthitis. In the diffuse destructive labyrinthitis, seen at times, accompanying basal skull fractures involving the petrous bone, the test indicates a perceptive form of deafness in addition to other findings.

In neurolabyrinthitis syphilitica, there is bilateral deafness, not as pronounced as in the hereditary form, with the likelihood of marked differences between the two sides, and functional findings indicative of involvement of the perceptive apparatus.

This article refers in an interesting manner to many of the important phenomena associated with involvement of the labyrinth. The last word has surely not been said on the subject of either the vestibular or cochlear tests, and in this paper attention is called to many points which have been under investigation for a long time, some of which have been fairly definitely proved, while others will require further study for their elucidation.

BEZOLD'S HEARING OR "SPEECH AREA"

Kompanejetz [21] quotes Bezold as follows:

> Only the perception of tones lying between b-1 and g-2, inclusive, is essential to the understanding of speech; furthermore, these tones must be appreciated by the ear even if they are of medium intensity; if the duration of hearing of these sounds drops below a certain level (that is, from 5 to 10 per cent. of the normal), speech will not be understood. If there is bilateral loss of this total range, the hearing for speech is usually gone. The converse of this is not necessarily true, for even if the whole range from b-1 to g-2 is present, the hearing of speech is not retained in all cases.

21. Kompanejetz, S.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **2**:309 (July) 1925.

Bezold explains this apparent incongruity on the theory that in these cases there is no disturbance in the inner ear, but instead a lesion of that portion of the central nervous system which gives impaired speech but not impaired audition; that is, "word deafness." Therefore he regarded the tonal range of b-1 to g-2 as of such vital importance to the perception of speech, because this area corresponds fairly accurately with the tones found in the various vowels.

This author examined a number of deaf mutes with the Bezold-Edelmann continuous series of forks. In eight cases the findings corroborated Bezold's dictum, that when the range of b-1 to g-2 is heard at least from 5 to 10 per cent. of the normal, the vowels were understood. In the second group of seventeen cases when the tones of b-1 and g-2 were not heard, or, if so, less than from 5 to 10 per cent. of the normal duration, there was no hearing for speech; this group also confirms Bezold's views. In the third group, were five whose findings differed from Bezold's postulates in three particulars.

1. One patient heard speech, even though the tones of b-1 and g-2 were heard less than 5 to 10 per cent.

2. In two subjects, the range of b-1 and g-2 was entirely lost in one ear and yet some hearing for speech remained.

3. In one subject, there was more than 10 per cent. hearing of the range of b-1 and g-2 in one ear, and yet there was complete speech deafness. The author admits this might be an instance of "word deafness."

Kompanejetz concludes that the correlation between the perception of the tonal range of b-1 and g-2 and the hearing of individual vowels and consonants on the one hand, and the pitch of these speech sounds on the other, does not always conform to Bezold's dicta.

It has been known for a long time that the overtones of some of the vowels have a much higher pitch than that which would be included in the speech area given by Bezold years ago. One of the highest overtones of the vowel "e" for instance, has a pitch of about 3,000 double vibrations. While it is true that the fundamental tones of most of the sounds used in speech lie within the range originally described by Bezold as the "speech area," we are of the opinion that the whole subject should again be thoroughly investigated, in order to see whether the dicta of the great master of functional testing need any radical revision.

News and Comment

LOCAL SOCIETY MEETINGS

CHICAGO: Chicago Laryngological and Otological Society meets on the first Monday of the month from October to May at the Crystal Room, Great Northern Hotel. Chairman, Dr. E. H. Norcross; Secretary, Dr. A. A. Hayden, 25 East Washington Street.

CLEVELAND: Ophthalmological and Otolaryngological Section of Cleveland Academy of Medicine meets on the fourth Friday of each month at the Winton Hotel. Chairman, Dr. E. W. Garrett; Secretary, Dr. M. Paul Moto, Rose Building.

DENVER: The Colorado Oto-Laryngological Society meets on the first Saturday of the month from October to May, at the Assembly Room, Metropolitan Building. President, Dr. William C. Bane; Secretary, Dr. C. Howard Darrow, Metropolitan Building, Denver.

KANSAS CITY, MO: Kansas City Eye, Ear and Nose Society meets on the evening of the third Thursday of each month from September to May, at the Baltimore Hotel. The afternoons of the third Thursday of November, January and March are given over to clinical work. President, Dr. James May; secretary, Dr. A. E. Eubank.

MILWAUKEE: Milwaukee Oto-Ophthalmic Society meets on the third Tuesday of the month, at the University Club, at 6:30 p. m. President, Dr. John E. Guy; Sec.-Treas., Dr. John J. Brooks, Majestic Building.

NEW YORK: Otological Section of New York Academy of Medicine meets on the second Friday of each month from November to May, at 17 West 43d Street. Dr. James Morisset Smith, Chairman; Dr. J. L. Maybaum, 12 East 86th Street, Secretary. Laryngological and Rhinological Section of New York Academy of Medicine meets on the fourth Friday of the month from November to May, at 17 West 43d Street. Otolaryngological Section of the Kings County Medical Society meets on the second Wednesday of January, March and May, at 1313 Bedford Avenue, Brooklyn. Dr. Harry Meyersberg, Chairman; Dr. Charles Breitman, 210 Brooklyn Avenue, Brooklyn, Secretary.

PHILADELPHIA: Section on Otology and Laryngology of the College of Physicians of Philadelphia meets on the third Wednesday of each month from October to June, at 8:30 p. m., at the College of Physicians. Chairman, Dr. Fielding O. Lewis; Secretary, Dr. James A. Babbitt, 2117 Chestnut Street.

Abstracts from Current Literature

Ear

AN AURAL FOCAL SEPSIS AS A SOURCE OF NEURASTHENIA AND INSANITY. E. WATSON-WILLIAMS, Brit. M. J. **2**:10 (July 4) 1925.

The author wishes to draw attention to the effect of aural suppuration on the mental condition of a patient rather than its local effect on the hearing. In every insane patient the ears should be carefully examined. He quotes cases of neurasthenia, epilepsy and insanity that were immediately relieved when the focus of infection was removed by a mastoid operation.

Therefore, in considering operative treatment for chronic otorrhea, the effect of septic absorption on the mental as well as on the physical health must be remembered.

THE FUNCTION OF THE VESTIBULAR ORGAN AND THE CLINICAL EXAMINATION OF THE OTOLITHIC APPARATUS. F. H. QUIX, J. Laryngol. & Otol. **40**:443 (Aug.) 1925.

In order to simplify the clinical examination of the otolithic reflexes, just their influence on the tonus of the muscles of the arms is considered. Minute differences of tonus can be demonstrated by means of the past-pointing test. As disturbance of function of the semicircular canals also causes deviations in the past-pointing, the characteristic deviations for each macula and crista are given in detail after three general rules are laid down that apply equally to macula or to crista. This is followed by a short differential diagnosis. The significance of these reflexes in otoneurology is discussed, and it is pointed out that more accurate and earlier diagnosis will be possible as this method of examination is perfected.

The idea that all past-pointing arises from direction centers in the cerebellum is not correct, because past-pointing has been experimentally provoked from the frontal portion of the cerebrum. It can be shown that in a large proportion of cases the disturbance arises in the otoliths.

McNALLY, Montreal.

THE EDEMA EX VACUO OF THE PNEUMATIC ENDOSTEUM. WILFRIED KRAINZ, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:478 (Sept. 8) 1925.

Lack of ventilation by the eustachian tube sometimes causes accumulation of fluid in the tympanic cavity. This transudate is free of germs, according to Scheibe. The effect is not confined to the tympanic cavity, but, as Bezold stated, the changes caused by occlusion of the eustachian tube can be assumed to effect the most distant cells of the mastoid process. Brock was the first to demonstrate the absence of the microbes in the transudate. He did not study the lining of the mastoid cells. Only since Wittmaack's investigation concerning the pneumatization of the temporal bone has attention been paid to the mastoid process and its lining. The lining of the mastoid cells is essentially an endosteum rest layer which belongs to the bone, and it is covered with simple squamous cell epithelium. It was of interest to learn how this loose tissue was changed when the air was thinned in the cells. The

mastoid cells containing air develop from marrow containing spongiosa. The endosteum layer of the same is pressed to the walls by the atmospheric pressure. Under normal conditions it forms the endosteum of the bone, and furnishes the foundation for the epithelium. The shape of the osseous structure and the arrangement of cells are the result of two factors. One is the pressure of the epithelial sac with its atrophying and resorbing result, the other is the traction of the sternocleidomastoid muscle, which incites bone apposition and influences the structure of the mastoid process. A normal or completely pneumatized mastoid process can be recognized by the circumstance that air containing cells reach to the cortex, which is thin. The sizes of the cells do not vary much. Marrow containing spongiosa spaces are totally lacking: channels for the vessels are few. Minute marrow spaces are only present at the junctions of the framework. When a disturbance of the exudative processes occurs, the endosteum can increase in thickness. On the other hand, chronic inflammatory conditions may cause a phlegmasia of the endosteum rest layers. Phlegmasia, according to von Recklinghausen, is a combination of an active congestion, progressing from the focus of inflammation with a compression of the efferent veins caused by pressure produced by the focus. This occurs when, by obstruction of the capillary paths, the capillary vessel systems of the neighborhood are inundated and dilated. These conditions are characterized by a greater width of the pneumatic endosteum which is permeated by round cell infiltration. A small vacuolated edema of the endosteum structure may occur. The endosteum net may present the appearance of mucous cells by its thickened and swollen fibers. Between the two extremes, all kinds of variations exist. The configuration of the osseous skeleton and the architecture of the cell layer furnishes an absolutely certain indicator of the cause of the structural change, and a reason for the respective degree of a more or less pronounced arrest of pneumatization. It is possible to draw conclusions from the form and lay of the cells concerning the lining, and vice versa. It can be expected that the diminished pressure in the cells of the mastoid process may have the opposite effect of the pneumatization, namely, a loosening and broadening of the lining. It is necessary to distinguish such pictures from similar pictures. Partial arrest of pneumatization and conditions of chronic phlegmasia of the lining must be considered. The differentiation is sometimes difficult. The incompletely pneumatized temporal bones are in the majority. Pure occlusions of the eustachian tube are rare. Mostly they are mixed with inflammatory changes. These cannot be objects of investigation, on account of the probability that the inflammatory process can extend, at least to a very slight degree, to the middle ear cavities. At least it may cause a greater blood and lymph circulation.

Krainz describes a case of mechanical occlusion of the tube by colloid cancer infiltration. The patient, a girl, aged 19, died of colloid cancer which had filled the entire retropharyngeal and epipharyngeal space, and which had extended to the left side of the nose and the left sphenoidal cavity.

On the healthy right side, the tympanic cavity and the antrum did not show any changes. In a few epitympanic cells small rests of a hyaline, purely serous fluid were present. The mastoid process was entirely pneumatized. The cortex was narrow and closed. The walls of the cells were thin and radiated more or less. The architecture of the cell system was normal. The bone was quiescent everywhere. The pneumatic endosteum was very narrow, atrophic and showed few vessels. The pneumatic epithelium was flat and atrophic. The cells were free and were without contents.

The tympanic cavity on the left side contained pure serous fluid with some cells, but no leukocytes. The mastoid process was normal and completely pneumatized. The cortex was thin; the cell walls radiated more or less. The architecture of the cell system was normal. Everywhere the bone was quiescent, only in some vessel channels some slight processes of apposition existed. The lining of the tympanum and the antrum was very much thickened and cushionlike. The vessels were filled to the limit. The lymph spaces were very wide. There was no cell infiltration; the epithelium was flat everywhere, only near the drum membrane at the floor of the tympanum it was cylindric for short stretches. The mastoid cells showed a very much thickened endosteum, so that the lumina were slit-like, narrow, and showed the configuration of a fishtail. The few vessels were well filled. The capillaries were filled to the limit and the lymph channels were very wide. The meshes of the endosteum were very wide with a large vacuolated edema. The fibers of the endosteum were tender, their structure was dissolved, and they were arranged perpendicular to the epithelium. There were few nuclei in the cells of the endosteum. There was no round cell infiltration, and no newly formed connective tissue. The thickening of the endosteum layer was less in the larger cells than in the small cells. In the latter the free lumen had disappeared almost completely. The epithelium was flat and atrophic. Even when the lumen was gone, there were no epithelial adhesions. In the pneumatic spaces there was serous fluid with few cell elements, just as in the tympanum.

Krainz reports a second case in which the conditions were more complicated. The patient, a woman, aged 34, two years previously had complained of pain in her right ear. It was reported that the drum membrane was incised twice without subsequent suppuration. There was a tumor in the nasopharynx which led to death in about one year. The necropsy showed the presence of a basal cell carcinoma of the right pterygopalatine fossa, which had progressed toward the base of the skull, and toward the orbit. The sphenoidal bone was affected and the dura was arroded. On the left side, which showed no tumor, the tympanum was filled with pus. The lining was thickened. The epithelium was high cubic to columnar. The drum membrane was retracted. Several connective tissue synechias were found between the hammer and anvil, and the upper wall of the tympanum, and between the head of the stapes and the promontory. The mastoid process showed numerous but irregular cells. The cortex was thick and compact with very small marrow spaces. The walls of the cells were thick, clumsy, and irregularly arranged. Concentrically arranged layers were noticed which caused a thickening of the cell walls. Sclerotic regions were found toward the ear canal and the tip. The endosteum of the larger cells was somewhat thickened and in a state of chronic phlegmasia. In the smaller cells it was edematous and loosened. The vessels were not overfilled. The epithelium was flat or cubic. In the lumina of the pneumatic spaces, various contents were found. In the larger spaces a purulent exudate rich in cells was encountered. Frequently the cells and the serum were separated in layers. In some smaller spaces only a serofibrinous fluid was found with single cell elements. The endosteum did not show any round cell infiltration. The bone was mostly quiescent, only in spaces slight processes of apposition could be noticed. On the diseased side, the eustachian tube was permeated by an osteoclastic, edematous carcinoma, rich in connective tissue. The vessels of the labyrinth capsule showed cancer cells. In the tympanum an exudate rich in cells was found. The hammer handle was drawn inward, the lining of the tympanum was mostly low, showing round cell infiltration.

The epithelium was flat or cubic. In the mastoid process numerous irregular cells were found. The cortex was thick and sclerosed. The cell walls were thick, mostly with concentrically arranged appositions. Toward the meatus and the middle cranial fossa, isolated regions containing fat marrow spongiosa were found, which were separated from the pneumatic cells by compact trabecular framework. The bone was mostly quiescent. In the vessel spaces few processes of transformation were present. Some isolated very large spaces containing air were found besides many smaller ones. The endosteum layers showed many variations. In the largest spaces they were sometimes low and fibrinous, and showed a chronic small vacuolated edema in a thickened fiber net. In other places, for instance in the smaller places, the endosteum was very much broadened and loosely separated into fibers. These seemed to be somewhat swollen and their course was more or less perpendicular to the epithelium. They contained a large vacuolated edema. Here, the blood and lymph tracts were very much extended. Most cells showed an exudate. When an exudate was imposed, the endosteum appeared to be lower than in the free spots. This was especially noticeable in the large spaces. The exudate was mostly mixed with cells, contained fibrin and was frequently stratified. The epithelium was entirely flat, in some places flat and cubic.

In the second patient, on the left side, which was free of a tumor, there was a quiescent condition in the middle ear after preceding inflammatory proceses. The processes took place partly during the pneumatization. This side showed complicated conditions. On the right side, which was affected by the tumor, the occlusion of the tube was imposed on ambiguous anatomic conditions. It was difficult to decide what tissue changes previously had taken place, before the occlusion of the tube had occurred. There was an exudate in the tympanic cavity, rich in cells, which could not be attributed to the occlusion of the tube, yet the nature of the lining of the tympanic cavity did not allow the assumption of an acute or recent inflammation. Its small height and the form of the epithelium pointed to an inflammation healed long ago, perhaps during pneumatization. The exudate in the tympanic cavity was apparently a serous exudate which had no connection with the lining of the tympanic cavity. Bacterial infection had not taken place. The absence of otherwise typical synechias and tissue bands in the tympanic cavity made it improbable that a suppuration had been present.

The clinical observation of the first case showed an occlusion of the tube. The increased retraction of the drum membrane and the functional test, which showed an affected sound conducting apparatus, established the diagnosis with certainty. All signs of an inflammatory and infectious disease were missing. This picture did not undergo any changes until death. Concerning the nature and origin of the changes of the endosteum, above all the arrest of pneumatization came into consideration and then inflammatory changes. If the change dated from the time of pneumatization, the architecture of the osseous framework would not have been normal, but irregular and clumsy, corresponding to a type found in incompletely arrested pneumatization. Furthermore, the lining should have been either in a state of chronic phlegmasia or else have shown the result of a former diseased condition, by being fibrously thickened and broadened. The microscopic picture shows that this was not the case. It could not have been the result of an inflammation, because there were no suppurative effusions into the lumen of the cells, no processes of organization, and no plastic changes with epithelium bridges. There were no signs of more or less plain processes of rebuilding of the osseous cell walls, no

processes of apposition at the lumen, no processes of resorption with the lasting traces of lacunary resorption. Also it could not have been an acute inflammation, because there was no acute inflammatory edema with exudation and extravasated matter, with leukocytes and round cell infiltration. The only cause, per exclusionem, was the existing occlusion of the eustachian tube, and the picture was that of an ex vacuo effect in the middle ear and in the pneumatic spaces. A number of positive proofs can also be adduced. The form of the lumina of the cells can be mentioned. In the original, each lumen was approximately round, more or less like a sphere corresponding with the vesicular form of the epithelial sac created by internal pressure. If the layer of endosteum had been thick from the beginning, or if it had been broadened by pressure from the vessel net, or from the endosteum tissue, the lumina would have remained still more or less respectively spherical. Never could slit — T — and fishtail shaped crosscut-pictures be observed under such circumstances. These can only be explained by virtue of changes, respectively of decrease of the form shaping and form preserving influence of the internal pressure. If this pressure is suddenly diminished, the equilibrium of the form preserving forces is disturbed. Then the vesicle sac is deprived of its support and it collapses. In this manner the crosscut-pictures present themselves and show no decrease of the former extent of the surface. On account of the change of the surface tension, the endosteum layer can develop its meshes. Into these meshes an increased amount of fluid may travel from the lymph paths and lymph spaces. Edema is caused secondarily and ex vacuo. This edema is plainly differentiated from any inflammatory and chronic edema by its large vacuolated spaces and the immense width of the lymph paths. The blood vessels are very wide but do not show any extravasation. This speaks against an increased arterial pressure. It is also remarkable that the edema, which lasted for several months, was not accompanied by new formation of fibers. The epithelium had not changed, was not torn, and did not show any tendency toward adhesions or bridge formation. All this shows that rarefaction of air in the epithelial lumen may produce changes of form, but does not incite changes of proliferation. If complicated conditions exist, for instance, a more or less arrested pneumatization or residues of former inflammations and connected with a plain occlusion of the eustachian tube, then the changes occurring under those conditions could not be recognized unless a case as described before could be cited for comparison. The second case furnishes an example of complicated conditions. The lumina of the pneumatic spaces were not arranged as in the first case, slit and fissure like. They remained round, respectively spherical. It is most probable that the layers of endosteum could not develop so quickly, because of a condition of chronic phlegmasia or, respectively, because of the more pronounced fibrous thickening. With the aid of the first case, the effects of the occlusion of the tube could also be recognized in the second case. In the second case, an edema ex vacuo had developed on the side affected by the tumor. The other side, which was not affected by the tumor, could be utilized by virtue of the similar degree of pneumatization, to reconstruct the picture of the character of the endosteal lining as it had existed before. Krainz comes to the conclusion that the view of the form preserving influence of interior pressure on the shape of the lining of the mastoid process has been strengthened, in view of the fact that the decrease of pressure, in the cases reported, has shown those tissue changes which could be expected.

AMBERG, Detroit.

Larynx

CONCERNING THE LOCALIZATION OF THE SUPERIOR LARYNGEAL NERVE FOR THE PURPOSE OF RESECTION. FRITZ BOCK, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:541 (Sept. 8) 1925.

Bock found that the location of the superior laryngeal nerve is always the same, contrary to the location of the artery. Its course is on the thyrohyoid membrane, about in the middle between the large cornu of the hyoid bone and the upper border of the thyroid cartilage, forward under the hyothyroid muscle. Later it penetrates the membrane. When it reaches the thyrohyoid muscle, in most cases, it is divided into several branches which gradually spread. The thickness of the nerve varies, but it is always easily found at the border of the thyrohyoid muscle, almost exactly in the middle between the tuberculum thyreoideum and the large cornu of the hyoid bone. It is different with the artery. Bock examined both sides of twenty fresh specimens. While the nerve always took the course before described, the artery did not penetrate the thyroid membrane in 7.5 per cent., but took its course through a foramen thyreoideum which was situated directly under the tuberculum thyreoideum superius. In the rest of the cases, the artery, varying much in caliber, was not even like the nerve in regard to its origin and to its course. A foramen thyreoideum seems to be much more frequent than is generally supposed. Bock looked in fresh larynxes only for a foramen, when there was an anomaly of the superior laryngeal artery. Therefore, he examined another sixty old larynxes preserved in formalin. In the 120 cases (each side counted by itself), a foramen thyreoideum was found forty-four times, or 36.7 per cent. The hardness and age of the specimens did not permit him to see what purpose the opening served. According to Luschka, it almost always serves the superior laryngeal artery in its abnormal course, rarely also the superior laryngeal veins or the external branch of the superior laryngeal nerve. In two of the sixty specimens the upper horn of the thyroid cartilage was missing on both sides. What conclusions can be drawn concerning the method of severing the superior laryngeal nerve? The superior laryngeal nerve takes a definite, well defined course; the artery does not. Why, therefore, should the artery be looked for and the large vessels of the throat, which are frequently surrounded by swollen glands, be exposed? The nerve is always found when one proceeds by going into the depth at the border of the exposed thyroid muscle, about 2 cm. above the tuberculum thyreohyoideum which can be palpated with certainty through the skin. The nerve lies on the membrana thyreohyoidea. The following method can be followed. An incision is made about 1 cm. in front of the sternocleidomastoid muscle, and in a somewhat acute angle with it from the hyoid bone to the middle of the thyroid cartilage. After the skin, the platysma and fascia have been incised, the omohyoid and thyrohyoid muscles are freed. The lateral border of the latter traverses the tuberculum thyreoideum, which can be felt plainly. The nerve is now looked for about 2 cm. above the tuberculum, at the border of the thyrohyoid muscle. It is found in most instances, exactly in the middle between the tuberculum thyreoideum and the hyoid bone on the thyrohyoid membrane. In most cases it divides itself like a brush into several branches, which remain, however, close to each other and then enter the larynx through the membrane. Bock claims the following advantages for his method.

1. It is not necessary to expose the large vessels.

2. The orientation is not made difficult by a superior laryngeal artery which takes an abnormal course.

3. Besides the platysma, no muscles must be severed.

4. The time of operation is shortened.

THE TREATMENT OF STENOSIS OF THE LARYNX. ALEXANDER IWANOW, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:568 (Sept. 8) 1925.

During the last decade, the number of patients suffering from stenosis of the larynx has grown. During the Great War, injuries of the larynx occurred very frequently, and the repeated epidemics of typhus frequently caused inflammations of the larynx with subsequent stenosis. Many patients were seen, on whom a tracheotomy had been performed, and who were condemned to carry a cannula during their whole life if no help was offered. A special department was created to take care of these patients. For more than three years, 161 patients (151 men, six women, and four children) were admitted. Besides these, Iwanow treated another forty-one patients in the clinic.

Patients	In the Department of Laryngology	In the Clinic	Total	Per Cent.
Admitted	161	41	202	100
Completely cured	59	27	86	43
Stoma not stitched. Breathing made possible again	31	..	31	15
Discharged completely cured	7	8	15	7
Died	6	6	12	6
Still under treatment	58	..	58	29

The etiology was as follows: typhus, 141 cases; typhoid fever, 22; recurrens, 5; diphtheria, 6; injury, 24; noninfective perichondritis, 4. Among 202 patients, breathing had been reestablished in eighty-six (43 per cent.) with closing of the stomas by stitching, in thirty-one without this help (15 per cent). This large number is explained by the refusal of the patients who wanted to take advantage of being invalids. In all, eighty-six plus thirty-one equalled 117 (58 per cent.) who were cured. Of the twelve who died, only one death could be attributed to the operation (postoperative pyemia). There was no aspiration pneumonia in any case. The duration of treatment is quite long. It depends on the nature and degree of the disease of the larynx, and on the method of treatment. In the beginning of Iwanow's work, it took one or two years, or even a longer time. Nowadays, the time is shorter. The treatment lasted for two, three, four, five, six, nine, eleven, twelve, thirteen, fifteen, sixteen, eighteen, twenty, twenty-two, twenty-four months with four, six, four, five, eleven, two, five, two, one, two, one, one, one, one, two, patients respectively.

The shortest treatment was of patients in whom the stenosis was confined to the lower portion of the larynx, immediately at the opening for the tracheotomy, and in those in whom there was no complete splitting of the larynx, and who came with free respiration to have the opening closed by stiching. The longest time (more than a year), was necessary with patients in whom a wide opening of the larynx for a formation of a large stoma was made. The average time of the treatment at present is from six to eight months. The surgical treatment is divided into four periods. The first period comprises the fissure of the larynx and the removal of the changes which present themselves; the second period, the methodical widening of the larynx; the third, the time of control, in which it is observed how permanent the widening of

the opening of the larynx remains; and the fourth comprises the plastic closure of the remaining opening (stoma).

Iwanow enters thoroughly into the etiology of the disturbance and into the details of treatment, which should be read in the original.

AMBERG, Detroit.

Nose

BILATERAL PAPILLITIS ASSOCIATED WITH ACCESSORY NASAL SINUS DISEASE AND NEPHRITIS. C. W. TOOKER, Am. J. Ophth. **8**:878 (Nov.) 1925.

The author reports a case of a woman, aged 24, who complained of headaches, poor vision and diplopia, all developing within a month. She had frequently been dizzy and nauseated, and often had vomited. About ten days prior to her visit, she began to see double.

Examination.—Vision in the right eye was 20/250, in the left was 6/200. Each optic disk was elevated approximately 6 diopters. After leaving the region of the disk, the vessels disappeared and reappeared in the edematous retina. The surface of the disk was marked by some yellowish-white splotches of exudate. The retina was edematous. In the macular region were several whitish streaks, resembling somewhat the exudates in albuminuric retinitis. Some few small hemorrhages could be seen scattered throughout the fundus. Neurologic examination was practically negative. The spinal fluid was normal.

Roentgen-Ray Examination.—The left frontal portion of the skull showed a hazy, rarefied appearance, slightly suggestive of intracranial pressure; and posterior to this region there appeared an area of increased density, which might indicate the presence of tumor; not very distinct. The left anterior sinus seemed cloudy. A cranial decompression was considered because of the elevation of the disks and failing vision, but was deferred until other examinations had been made. Rhinologic examination gave evidence of infection of the left posterior ethmoid cells. Blood pressure was 210 systolic, and 140 diastolic. The urine contained albumin and casts. The temperature varied from 99 to 100.5 F., with the pulse varying from 90 to 100.

Three days after entering the hospital, the anterior two thirds of the right middle turbinate was removed. The ethmoid cells on both sides were exenterated, and evidence of infection in the left posterior ethmoid cells was found. No free pus was present. During the afternoon and evening of the day the nasal operation was performed, the patient lost about 500 c.c. of blood from the nose. Three days later the blood pressure was 170 systolic, 136 diastolic. The urine contained albumin and many hyalin casts. Five days later, the swelling of the disks had decreased to about two diopters. Ten days after the nasal operation there was no diplopia and the ocular movements were almost normal.

The author discusses the question of differential diagnosis between papillitis resulting from renal disease and nasal sinus disease. He quotes Sluder as having reported several cases of bilateral choked disk accompanying accessory nasal sinus infection. In one of these cases the swelling measured 6 diopters in one eye and 8 diopters in the other. Negative neurologic examinations were made in these patients when the condition was relieved by postethmoid-sphenoid operations. When last seen by the author, the patient still had albuminuria and hypertension.

EXOPHTHALMOS A COMPLICATION OF NASAL SINUSITIS. C. F. YERGER, Am. J. Ophth. **8**:882 (Nov.) 1925.

The author starts out his article by saying that exophthalmos due to nasal sinus disease is invariably unilateral, and the most frequent cause of unilateral exophthalmos is suppurative sinusitis. The most common orbital complication of sinusitis is orbital cellulitis and abscess, which is usually the result of frontal or ethmoid sinusitis, involving the former in adults and the latter in children. The records of the Illinois Eye and Ear Infirmary for the past ten years were examined to determine the incidence of suppurative sinusitis and orbital phlegmon and exophthalmos. There were recorded 357 cases of empyema of the accessory nasal sinuses, which were involved as follows: frontal, 45 per cent.; maxilliary, 28 per cent.; ethmoid, 24 per cent.; and sphenoid, 3 per cent. Of 150 cases of orbital phlegmon, 146 were recorded as orbital cellulitis and four as orbital abscess. There were thirty-seven cases of exophthalmos recorded, but they were not classified as to etiology. Orbital phlegmons were four times, and empyemas of the nasal sinuses were ten times as frequent as exophthalmos.

The author gives a summary of seven cases of exopthalmos secondary to nasal sinus disease. The frontal sinus was involved in six cases, the ethmoid in five cases and the frontal, ethmoid and maxillary were involved coincidentally in three cases. There was one case of giant mucocele of the frontal sinus with absorption of the floor of the sinus from pressure necrosis. There were three cases of acute sinusitis and four of chronic sinusitis. Pus was observed rhinoscopically in only one case. A supraorbital swelling was present in four cases. Limitation of ocular movement was present in five cases, edema of the upper lid in five cases and chemosis in two cases. Ophthalmoscopic examination was negative. Four patients recovered and three died. Complications were meningitis, extradural abscess, sphenotemporal lobe abscess, frontal lobe abscess and serpens ulcer of the cornea.

The author mentions the anatomy and paths of infection, symptoms and differential diagnosis, prognosis and treatment. He feels that it is only by external exploration of the orbitofrontoethmoid wall that pathologic changes can be definitely ascertained, and adequate drainage established for both the orbital cavity and the nasal sinuses. The Killian incision is the best for the orbitofrontal operation. All diseased tissues must be thoroughly removed, and free drainage should be established between the orbital cavity and nasal sinuses.

OPTIC NEUROPATHY AND SPHENOETHMOID DISEASE. C. M. MILLER, Laryngoscope **35**:687 (Sept.) 1925.

Miller gives a review of the work of Ziem, published in 1886-1887; Killian, in 1887; Onodi, in 1908; with mention of the work done by Leon White on the roentgen-ray method of measuring the size of the optic nerve canal.

The author feels that in the diagnosis of cases of optic neuropathy, every means for systemic and local examination should be used, and even then a diagnosis by exclusion has sometimes to be arrived at, and what is in reality an exploratory operation performed. The possibility of a retrobulbar neuritis from a focus of infection far removed, or alcohol, tobacco, quinin or any other drug that may be the cause of amblyopia must be kept constantly in mind. Syphilis here, as in every other organ of the body, is a frequent etiologic factor, and may manifest itself either as in active neuroretinitis or in a retrobulbar neuritis with an ophthalmoscopic picture that is practically negative.

Roentgen-ray examination of the sinuses may show involvement, but a negative plate or series of plates does not of necessity rule out the possibility of sinus infection nor decide against operation.

The author quotes Van der Hoeve as saying that: "the rhinologist cannot say with absolute certainty that a person has no sinus affection."

In the examination of the eye alone, factors to aid in the diagnosis may be present or absent. In a patient presenting blurred or decreased vision, the ophthalmoscopic examination may or may not show changes in the nerve head when the cause is a sinus disease. In the absence of any visible signs of optic nerve involvement, the symptoms of retrobulbar neuritis are sought.

The author mentions the symptoms — enlargement of the blind spot and narrowing of the field for red. Pain is not characteristic. The author feels that there is nothing absolutely characteristic of sinus disease as a cause of defective vision, to be obtained by examination of the eye alone. The field of vision is the point to be considered most carefully.

The author reports three cases, the first case being one of reduced vision with a spot before the left eye. Examination of the eyes showed optic neuritis, and during the time a thorough physical examination was being made, vision gradually became worse until it was reduced to light perception. Examination of the nose showed hyperplasia of the left middle turbinate. Following an operation, which consisted of removal of the left middle turbinate and uncapping of the ethmoid cells, there was gradual but steady improvement so that in three months the vision was 20/20.

The second was a woman, who complained of reduced vision in the right eye and inability to use her eyes for any length of time without severe headaches. Examination of the fundus showed nothing abnormal. The nasal examination showed some antrum and ethmoid disease on the right side. Following drainage of the right antrum and removal of the right middle turbinate with uncapping of the ethmoid cells, she improved steadily, so that twenty days after operation her vision, with correction, was 20/20, and she has been able to use her eyes with perfect comfort.

The third case was a woman, aged 38, who complained of failing vision for the past year, during which time she had been having nasal treatments — local applications and suction — but without benefit. On being examined, the vision was light perception in each eye. Examination of the nose showed a very large red middle turbinate on the right side, pressing against the septum. Ophthalmoscopic examination showed the optic nerves somewhat gray in appearance but otherwise normal. Physical examination was negative, except the blood Wassermann test showed four plus positive. The administration of arsphenamin intravenously brought about a gradual improvement of vision to normal; at the same time, the nasal condition improved.

The author concludes:

1. That the satisfaction in treating these cases will be greatly enhanced if the rhinologist himself will learn the use of the ophthalmoscope, not for the purpose of usurping the place of the ophthalmologist, but to follow more intelligently the progress of the case in all its details.

2. There is a class of cases of retrobulbar neuritis which seem never to progress to actual complete loss of vision or, at any rate, are very slow in their progress in this direction. These cases are never hopeless from the standpoint of restoration of vision as long as there is no picture shown by the ophthalmoscope of optic nerve atrophy.

3. The finding of one cause sufficient to account for the symptomatology does not justify us in ceasing to search for all the causes that may be present, and remedy them all in our efforts to restore vision.

4. Where no other cause of an optic neuropathology is found after exhaustive physical, neurologic and serologic examinations has been made, exploratory operation on the ethmoid and sphenoid is justified in the hands of the competent operator.

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The Nasal Sinuses as a Route of Infection in Encephalitis Lethargica. A. Lowndes Yates and Stanley Barnes, Lancet **2**:130 (July) 1925.

These authors recognize four types of inflammation of the nasal mucous membrane.

Type 1: The secretion consists of clear mucus and the cilia are either active or slightly fatigued.

Type 2: The inflammation is more severe and the secretion is mucopus.

Type 3: Micro-organisms are present and the mucus is altered by fermentation so that it is thin and partially toxin permeable; as a result toxins reach the mucous membrane.

Type 4: The mucous membrane is pale, the cilia paralyzed, the mucus secretion is absent or thin and like fluid. The absorption power of the mucous membrane is heightened.

In twenty-three cases of encephalitis lethargica (epidemic encephalitis) Type 4, inflammation was found around the opening of the sphenoidal sinus. It is suggested that the heightened absorptive power in these cases explains the manner in which the filter-passing virus reaches the tissues. The outbreak of encephalitis after the influenza epidemic in 1918 is probably explained by the virulence of the influenza causing a Type 4 sinusitis in these cases. In patients who developed the disease after chronic rhinitis, the bacillus of Friedlander or the pneumococcus was found.

In the patients with a history of acute rhinitis preceding the encephalitis, the *Staphylococcus aureus*, together with the pneumococcus, was found. The proteolytic power of these last organisms would rapidly change the mucous membrane to that of Type 4.

The heightened absorptive power of the mucous membrane can be demonstrated by injecting phenolsulphonephthalein into the sinuses. In a Type 4 case it will reappear in the urine in a relatively short period of time, but if the mucous membrane is relatively healthy the dye will not appear in the urine.

It is possible that a sinusitis of Type 4 may be a necessary precursor of encephalitis lethargica. The paths of infection are probably along the sheaths of the first division of the trigeminal nerve or the branches of the olfactory nerve rather than through the blood stream.

Paroxysmal Rhinorrhea. John Freeman, J. Laryngol. & Otol. **40**:561 (Sept.) 1925.

Paroxysmal rhinorrhea is the symptom complex produced whenever a foreign protein comes into contact with the nasal mucous membrane of a person who is sensitive to that protein. Hay-fever is the type here considered, and it is pointed out that though the pollen causes distress when it reaches the nasal mucous membrane of a sensitive subject, it is quite innocuous to a normal person.

The foreign proteins are legion, and they may reach the nasal mucous membrane in the inspired air or through the blood stream. As an example of each, two experiments were done. The nasal mucous membrane of a physician was sensitized with serum from a hay-fever subject. When he sniffed up a little grass pollen, he at once began to sneeze. In another experiment the author sensitized the inferior end of one of his own middle turbinates with serum from a subject who became ill whenever she ate eggs. He then drank an eggflip and his nose itched and became uncomfortable.

In hay-fever it is not only the nasal mucous membrane that is sensitive to grass pollen, for if it is introduced to the cutis vera there is a marked urticarial wheal. When introduced to the rectum in one subject it caused pruritis ani. In another subject, when pollen was put into the food, it caused grave urticaria, migrain, etc.

There is a list given of the protein idiopathies. The causal links are given as diathesis, protein irritant, a nervous factor and trauma.

It is often extremely difficult to discover the irritating proteins, but if it can be done it is well worth while.

McNALLY, Montreal.

Miscellaneous

THE FUNCTION OF THE SOFT PALATE IN SINGING (EXPERIMENTAL INVESTIGATION). L. D. RABOTNOFF, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:546 (Sept. 8) 1925.

1. The task of the soft palate in singing consists of separating the oral cavity from the nasal cavity and the nasopharynx. The more complete this separation is, the more favorable are the conditions for the resonance of the oral cavity.

2. In the best singers, the nose with its accessory cavities and the nasopharynx does not represent a part of the voice apparatus in singing vowels and consonants (except the nasal ones).

3. The inclusion of the nose as a resonance apparatus influences the sonorousness, strength and timbre of the voice very unfavorably, forcing and fatiguing of the same.

4. Most singers use the nose and the nasopharynx for voice formation. They do this at a disadvantage, because the fundamental qualities of the voice suffer. They use this resonance apparatus without rules. They include the same at times, and at times they exclude it.

5. The sounding (humming) in the nose is missing, not only when the palate shuts off the nasopharynx completely, but also when the gap behind the soft palate restrains itself to a certain minimum.

6. The participation of the nasal cavity and the nasopharynx in the formation of consonants leads to an indistinct pronunciation.

7. By pulling up the soft palate while singing vowels, the production of tunes of a certain timbre is accomplished, which is controlled by the ear.

8. In order to acquire a sound without nasal resonance, it is advisable that singers make use of artificial obturators of the nasopharynx for a short while.

9. Curvatures of the nasal septum and other anomalies of the nasal cavity have not a bad influence on the tune of the voice if they are not accompanied by symptoms of inflammation of the upper respiratory tract.

10. In deep inspiration, with great expansion of the thorax, the soft palate has the tendency to move downward.

AMBERG, Detroit.

Society Transactions

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLOGY AND LARYNGOLOGY (SPECIAL MEETING)

Nov. 12, 1925

FIELDING O. LEWIS, M.D., *Chairman*

MODERN METHODS IN THE EDUCATION OF THE DEAF CHILD. Presented by DR. M. A. GOLDSTEIN (by invitation).

Society's obligation to the deaf child is similar to that of the sick or crippled minor. In the past, the weight of this obligation has not been sufficiently recognized, and although progress has been made the public still does not respond to the aid of this group of deficients as readily or as intelligently as it does in making provision for the crippled or sick child. It is essential for the otologist to cooperate unselfishly with the teachers of the deaf. Too few otologists have accurate knowledge of the methods of training and the results that can be realized. Without this knowledge, he cannot give the most valuable and accurate advice to the parent consulting him relative to the care and training of a deaf child.

Dr. Goldstein divided deaf children into two main groups: (*a*) the biologic congenitally deaf and, (*b*) the pathologic congenitally deaf. In the former, embryonic distortion or malformation of the hearing organs have occurred. This deafness is rarely complete and in 90 per cent. of the subjects the function of the static labyrinth is in part preserved.

Eight deaf children were presented to the society, and the methods used by Dr. Goldstein and his teachers were demonstrated. Of special interest was the demonstration of the efforts made, and the results obtained, to secure tone perception and vocal tone expression in the child not possessing enough hearing to differentiate sound elements. This was accomplished by tactile sensations originating in a sounding piano.

Dr. Goldstein emphasized the necessity of early training. The age of 3 years is not too early. If education is too long postponed, laryngeal atrophy and ankylosis makes vocal expression difficult or impossible.

DISCUSSION

DR. PACKARD asked Dr. Goldstein to tell of his experiences with radio devices.

DR. GOLDSTEIN was of the opinion that such devices hold much promise, but at the present time they are so much entangled by commercialism that there is great difficulty in obtaining accurate information regarding their efficiency.

DR. GROOVER stated that the exhibition of the child taking a sentence by tactile sense from a megaphone was a remarkable demonstration by one totally deaf. If Dr. Goldstein could produce in groups results similar to this one produced singly, much would be contributed toward the education of the deaf child.

Book Reviews

DISEASES OF THE NOSE, THROAT AND EAR, MEDICAL AND SURGICAL. WILLIAM L. BALLENGER, revised by HOWARD CHARLES BALLENGER. Ed. 5. Philadelphia: Lee & Febiger, 1925.

This edition of Ballenger's textbook has received some substantial alterations and additions which materially improve the older text. It has always been a readable book, quite original in its method, or, one might almost say, lack of method. It is easy to appreciate why the book has been so popular. It is profusely illustrated and discusses at length details, especially those concerning operative technic. It is, on the whole, a rather remarkable textbook presenting an unusual compilation of facts and fancies in the field of otolaryngology. There is a tendency to emphasize things that are new, and it is hard to escape the impression that the more bizarre the new contribution may be, the more valuable it is appraised.

Several types of operations are often described for the same condition and not enough attention has been given to a consideration of what should constitute the proper indications for various operations. For these reasons, it can hardly be considered a safe guide to the beginner in the field of otolaryngology who is in need of the guidance of riper judgment regarding fundamental facts in otolaryngology and a clear statement of the symptomatology, pathology and particularly the treatment, especially the indications for operative treatment.

The volume is filled with details, the importance of which have been overemphasized apparently because the details were considered new by the author. This desire to present something new may be the reason for such illustrations as the one shown in Plate 9, entitled "An Adenoid Face," done in colors. This is a picture of fright rather than one presenting the characteristics of an adenoid face, but the picture is new. There are many excellent photographs extant, which accurately illustrate this condition. Again, on Page 310, the illustration of "Author's Case of Lupus of the Nose": There is apparently nothing in the illustration that is informing. The same is true of Figures 246 and 247.

The author has acquired the bad taste of the too frequent use of the pronoun "I," "author's case," "author's instruments," "author's methods," "author's operations," etc.

The text is compiled with very little attention to order or to logical sequence. The author seems to have rambled along discussing any phase of the subject at any point when an idea occurred to him. The result is an accumulation, which it must be very difficult indeed for the student or beginner to disentangle intelligently. An illustration of this tendency is the treatment of chronic suppurative otitis media, beginning on page 763. The author rambles along discussing such features of this disease as strike his fancy, but with no evidence that he has reached in his own mind a crystallized conclusion of the clinical phenomena of this condition. It would be difficult for a beginner to reach any conclusion as to what constitutes proper indication for operative interference in these cases, although the author does go to the extent of tabulating nine indications in addition to the general sweeping indication of failure to check the discharge by local treatment.

It is hard to see how a student who relies on the information gleaned from a book of this sort can avoid the risk of unnecessary operating. His conclusion must inevitably be that every case of chronic suppurative otitis media should be operated on, except perhaps that type in which the discharge ceases promptly after the application of a few local measures. Moreover, following the suggestion set forth on page 721, that any alterations in the nose should be looked on as an indirect cause for ear trouble, in which he includes such anatomic variations as exist almost universally in the nose such as "spurs, ridges, thickening, deflections of the septum and enlargement of the middle turbinates," the practitioner who has acquired a smattering of operative technic could keep himself busy treating (!), that is operating on, such patients for an indefinite period with these indications.

With due credit to the readability of the text, one can hardly escape the impression that most of the unusual popularity of the book has been due to the very things we criticize.

PLASTIC SURGERY OF THE NOSE. By J. EASTMAN SHEEHAN, M.D., F.A.C.S. Price $10.00. New York: Paul B. Hoeber, 1925.

This is an octavo volume of 249 pages, printed in large, clear type on excellent glazed paper. It represents the most lucid as well as the most complete presentation of the subject of nasal deformities and their surgical treatment that has come to our attention. The presentation of a subject of this kind necessitates a large number of illustrations. These have been excellently provided for, and with a text that is concise and precise, the various procedures are set forth with unusual clearness. There are, altogether, 177 illustrations exclusive of nine plates.

The stimulus brought to the field of plastic surgery of the face from the war injuries has served to develop this work as it has never been done before. It is a field that can only be successful in the hands of those whose interest and liking for it leads them to seek preparation which is quite apart from the usual preparation necessary for practicing in the field of otolaryngology. Heretofore, plastic surgery for the legitimate correction of nasal deformities has been left too much in the hands of questionable practitioners (beauty doctors), who prey on imaginary defects of supersensitive individuals. There is hardly need for a large number of operators to take care of the legitimate work in this field, but for those who have a special liking for it, this work by Sheehan will serve as an excellent and safe guide.

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